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FINAL REPORT OF ENGINEER DESIGN TEST OF SHELTER, ELECTRONIC EQU--ETC(U)
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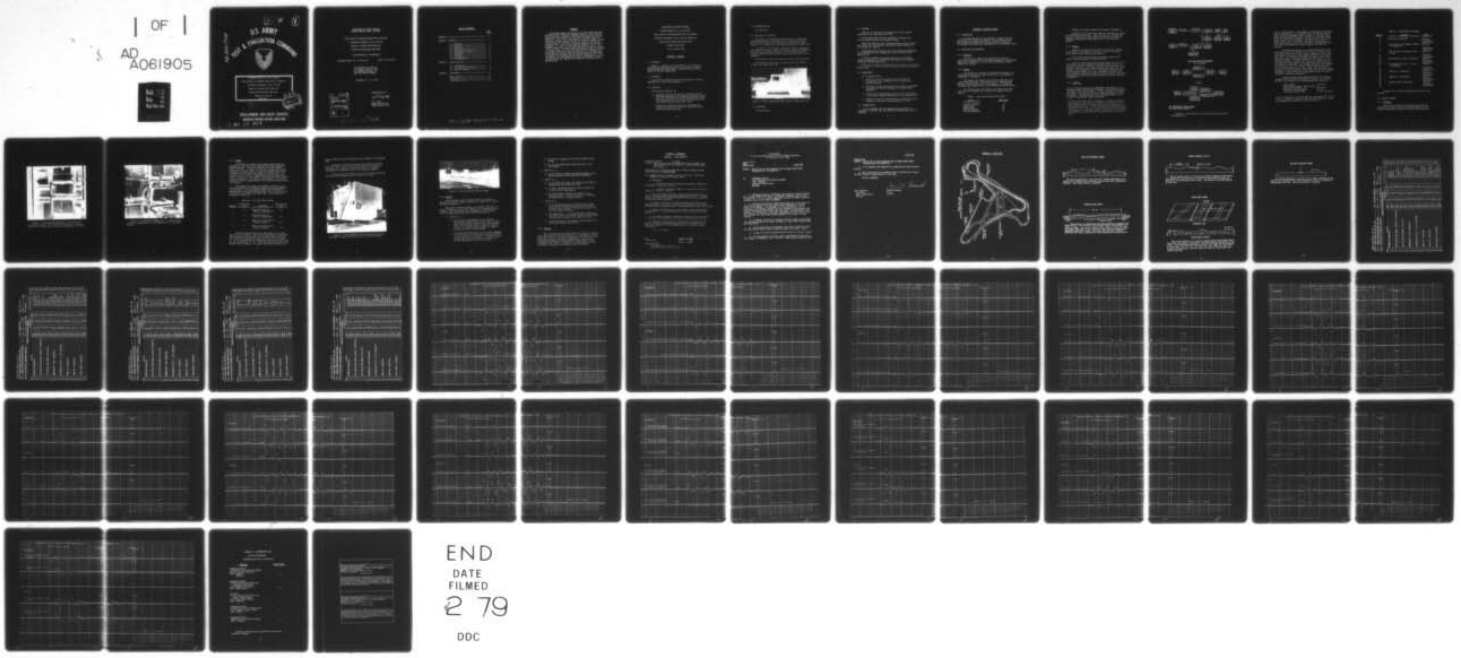

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US ARMY TEST & EVALUATION COMMAND

USATECOM PROJECT NO. 6-4-3112-05-G

FINAL REPORT OF ENGINEER DESIGN TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153, AND THE AN/GRC-122 SYSTEM (ROAD SHOCK AND VIBRATION AND RAILROAD HUMP TEST)

REPORT NO. DPS-1357

JUNE 1964

DEVELOPMENT AND PROOF SERVICES

ABERDEEN PROVING GROUND, MARYLAND

DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND, MARYLAND

FINAL REPORT OF ENGINEER DESIGN TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153, AND THE AN/GRC-122 SYSTEM (ROAD SHOCK AND VIBRATION AND RAILROAD HUMP TEST)

RDT&E PROJECT NO. 1G640306D488

USATECOM Project No. 6-4-3112-05-G Report No. DPS-1357

ANY REQUESTS FOR COPIES OF THIS REPORT SHOULD BE MADE TO COMMANDING GENERAL, US ARMY ELECTRONICS COMMAND.

PREPARED BY: G. C. HIOB

AUTHENTICATED BY:

R. P. WITT
Deputy Director for
Supporting Services

TABLE OF CONTENTS

ABSTRACT

An engineer design road test and a railroad hump test were performed on the electronic equipment shelter, S-153, which contained simulated components of the radio/teletypewriter system, AN/GRC-122. These tests were conducted to measure shock and vibration response and to evaluate the structural adequacy of the system during road transport on the M37 truck and during railroad hump tests. There was no apparent damage to the shelter or equipment as a result of road shock and vibration tests. The tiedown slings which were provided adequately secured the shelter to the M37 truck. Railroad hump tests produced numerous failures of equipment mountings within the shelter; it is apparent from these failures that the present mounting methods are inadequate to restrain the equipment during railroad transportation. It is recommended that the damaged mountings be redesigned or modified and that additional hump tests be conducted to evaluate these modifications.

DEVELOPMENT AND PROOF SERVICES

USATECOM PROJECT NO. 6-4-3112-05-G

FINAL REPORT OF ENGINEER DESIGN TEST OF SHELTER,

ELECTRONIC EQUIPMENT, S-153, AND THE AN/GRC-122

SYSTEM (ROAD SHOCK AND VIBRATION AND

RAILROAD HUMP TEST)

13 TO 15 APRIL 1964

SECTION 1. GENERAL

1.1 REFERENCE

Hagen, J., Johnson, R. W., and Tolen, J. A., "A Study Establishing Methodology Describing the Automotive Vehicular Vibration Amplitude Environment." Aberdeen Proving Ground. Report No. DPS-657, August 1962.

1.2 AUTHORITY

This test was authorized by first indorsement to letter, AMSEL-RD-GTE, 6 April 1964 (Appendix A).

1.3 OBJECTIVE

This test was conducted to:

a. Determine the shock and vibration response and the structural adequacy of the electronic equipment shelter, S-153, and the AN/GRC-122 radio/teletypewriter system when transported on the 3/4 ton, 4x4 cargo truck, M37, over adverse terrain (Munson Test Area).

b. Determine the shock and vibration environment the shelter and AN/GRC-122 system will encounter during railroad humping operations.

1.4 RESPONSIBILITIES

Not applicable.

1.5 DESCRIPTION OF MATERIEL

The shelter is of aluminum construction and is mounted on three equally-spaced longitudinal skids. Brackets are located on the top four corners for attaching lift or tiedown slings. Figure 1 is a general view of the shelter mounted on an M37 truck.

The interior of the shelter contained a heater, combination safe, chair, and racks to mount the various electronic components. All electronic components referred to by AN/ designation were actually simulated by metal plates having the same weight as the component.

Gross weight of the S-153 shelter as tested was 1250 pounds.

The prime mover used for all road tests was the standard 3/4-ton, 4x4, cargo truck, M37.

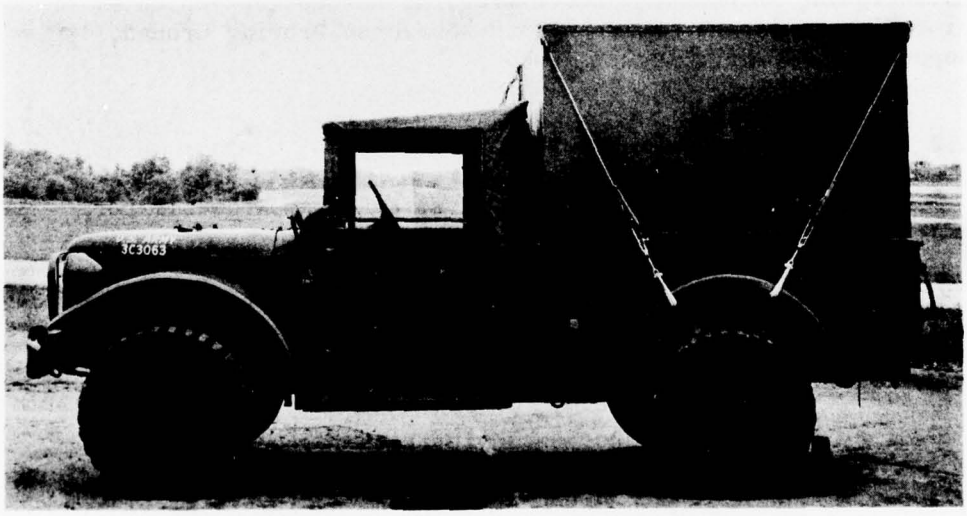


Figure 1: Shelter Mounted on Truck, Cargo, 3/4-Ton, 4x4, M37.

1.6 BACKGROUND

Not applicable.

1.7 FINDINGS

There was no indication of instability or other adverse conditions at any time during this test.

The tiedown slings provided adequately restrained the shelter during operation over adverse terrain.

Shock and vibration levels recorded during the road testing were within the range normally encountered during operation on the various test courses.

Restraining devices used on some of the electrical equipment were inadequate and were damaged as a result of the railroad humping tests.

A vertical support in the left side wall of the shelter structure adjacent to the AN/GRC-106 mounting rack was damaged during the railroad hump tests.

There was no damage to the exterior of the shelter, the blocking or the tiedowns as a result of shock generated during the railroad humping test.

1.8 CONCLUSIONS

It is concluded that:

a. Stability of the M37 truck with the S-153 shelter and equipment was satisfactory for all speeds and conditions tested.

b. The tiedown slings provided for road transport adequately restrained the shelter throughout the limited tests conducted.

c. Blocking and tiedown methods used to attach the shelter to the flatcar appeared adequate for rail transportation.

d. Mounting fixtures for some AN/GRC-122 components are not adequate to withstand railroad humping at 9.2 mph.

1.9 RECOMMENDATION

It is recommended that the damaged mounting fixtures be redesigned or modified and that additional railroad hump tests be conducted.

SECTION 2. DETAILS OF TEST

2.1 INTRODUCTION

An engineer design test was performed to obtain data and information to evaluate the integrity of the proposed design and to determine changes which may be necessary to meet the environmental and functional requirements of the equipment tested.

2.2 ROAD SHOCK AND VIBRATION

2.2.1 Objective

This test was conducted to determine the shock and vibration environment and the structural adequacy of the proposed design when transported on an M37 truck over adverse terrain (Munson test courses).

2.2.2 Method

The shelter was received in satisfactory condition. No defects were observed in either the shelter or the components (simulated) it contained.

The shelter was secured to the 3/4-ton truck using the tiedown cables provided. The shelter and all assemblies and structural members were checked for rigidity. All equipment mountings were checked prior to and periodically during testing.

The 3/4-ton truck, with shelter, was driven five times over each of the Munson test courses at the speeds shown in Table I.

Table I. Shock and Vibration Test Speeds

Course	Speed, mph
Six-inch washboard	5
Belgian block	20
Spaced bump	20
Radial washboard	15
Two-inch washboard	10

Profiles of the test courses are included in Appendix B.

Recordings of the shock and vibration data were made during the first lap of each course. After the test, the interior and exterior of the shelter were inspected to determine evidence of breakage, deformation,or loosening of parts and structural members.

2.2.3 Results

There was no indication of vehicle instability or damage to the shelter or AN/GRC-122 system as a result of operation over adverse terrain (Munson test course).

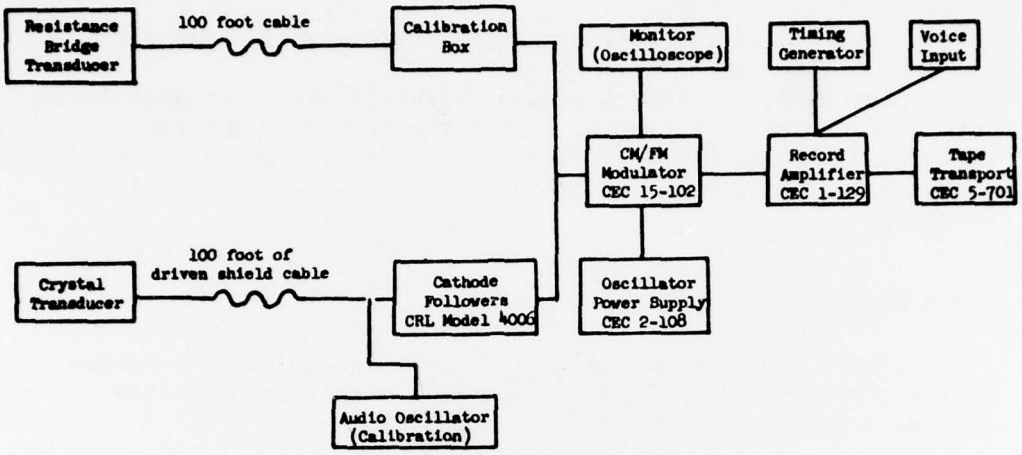
The tiedown slings provided adequately restrained the shelter during operation over adverse terrain.

Shock and vibration levels[a] recorded during the road tests were within the range normally encountered during operation on the various courses. Generally, the rms values were below 0.5 g; however, there were several (six) instances when this value was exceeded. The maximum rms value of 0.94 g was recorded on the 2-inch washboard course at 10 mph. Amplitude distribution for each transducer location for each test course, together with major frequencies extracted from spectral analysis data, are contained in Appendix B.

2.2.4 Analysis

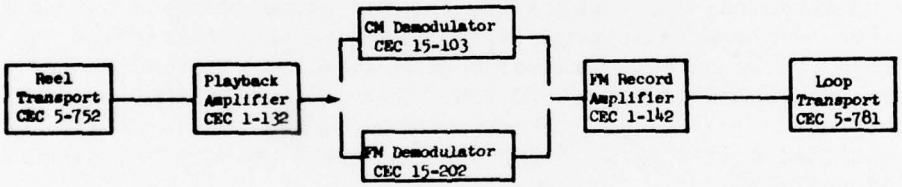
2.2.4.1 Recording and Analysis Equipment. The outputs of all transducers were recorded on Consolidated Electrodynamics Corporation Model 5-701 tape recorders. A block diagram of the recording system, loop transfer, and loop analysis equipment is shown in Figure 2. Frequency range of the recording system is dc to 600 cps for resistance bridge transducers.

[a]As used in this report shock response is a response of significant amplitude that occurs at a repetitive rate lower than the lowest damped natural frequency of the items (vehicle and onboard gear) under test. Significant shock is considered present when the ratio of crest g to rms g (amplitude distribution analysis) exceeds 8:1. When this ratio is less than 8:1 the response is defined as vibration and can best be described by the rms g level.

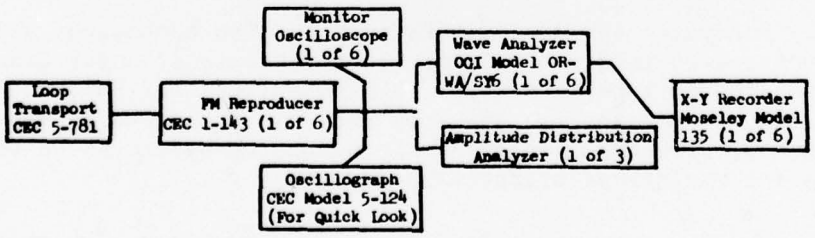


BLOCK DIAGRAM OF LABORATORY INSTRUMENTATION

REEL TO LOOP TRANSFER



LOOP ANALYSIS



CEC - Consolidated Electrodynamics Corporation
OGI - Ortholog Division - Gulton Industries
CRL - Columbia Research Laboratories

Figure 2: Block Diagram of Field Recording and Laboratory Instrumentation.

2.2.4.2 Data Reduction. Data acquired in the field in tape-reel form are demodulated in the laboratory and transcribed onto tape loops using the arrangement shown in Figure 2. The loop transporter and associated electronics conform to Inter-Range Instrumentation Group (IRIG) standards. The output of the loop transporter is fed into a multichannel automatic data processing system which dissects the data in two forms: amplitude distribution (amplitude probability density function) and spectral analysis.

The amplitude analyzer is a semiautomated device which determines and records the per cent of time, in relation to the total sample time, that the data signal exceeded 18 levels (nine levels positive and nine levels negative around a zero-voltage base line). This analyzer determines the amplitude for the full frequency spectrum. Frequency response of this system is 2 to 3000 cps; however, the range can be varied by changing the ratio of playback to record speed of the tape loop without destroying the integrity of the data. The frequency range for data included in this report was 0.5 to 200 cps. Results of these analyses are used to determine the root mean square (rms) deviation, the amplitude that was exceeded 1% of the time, and the crest (maximum amplitude). These three values were computed using the method outlined in Reference, paragraph 1.1.

Spectral analyses were made using wave form analyzers equipped with selectable fixed bandwidth filters. For analysis of data in this report, the following parameters were used:

Sample length	15 seconds
Loop playback speed to record speed	4:1
Smoothing (averaging) time	Loop length
Effective filter bandwidth	2.5 cps
Oscillator scanning rate	0.5 cps per second

2.2.4.3 Transducers. The test item was instrumented with $\pm$ 25 g and $\pm$ 15 g Statham Laboratories Model A5A accelerometers. These accelerometers were located as listed in Table II.

Table II. Accelerometer Locations

Channel	Location	Plane
1	AN/GRC-106 (simulated)	Vertical
2		Transverse
3		Longitudinal
4	Left vertical rack member, adjacent to AN/GRC-106	Vertical
5		Transverse
6		Longitudinal
7	Left vertical rack member, floor level	Vertical
8		Transverse
9		Longitudinal
10	Modem MD-522 ( )/GRC, (simulated)	Vertical
11		Transverse
12		Longitudinal
13	Teletypewriter TT-76 ( ), GGC, (simulated)	Vertical
14		Transverse
15		Longitudinal
16	Dummy box 1 (simulated)	Vertical
17		Transverse
18		Longitudinal
19	Dummy box 2 (simulated)	Vertical
20		Transverse
21		Longitudinal
22	Duplex AN/UGC-4 (simulated)	Vertical
23		Transverse
24		Longitudinal

Figures 3 and 4 show the transducer mounting at each location.

2.3 RAILROAD HUMPING

2.3.1 Objective

This test was conducted to determine the shock and vibration environment and the structural integrity of the proposed design when subjected to railroad hump operations.

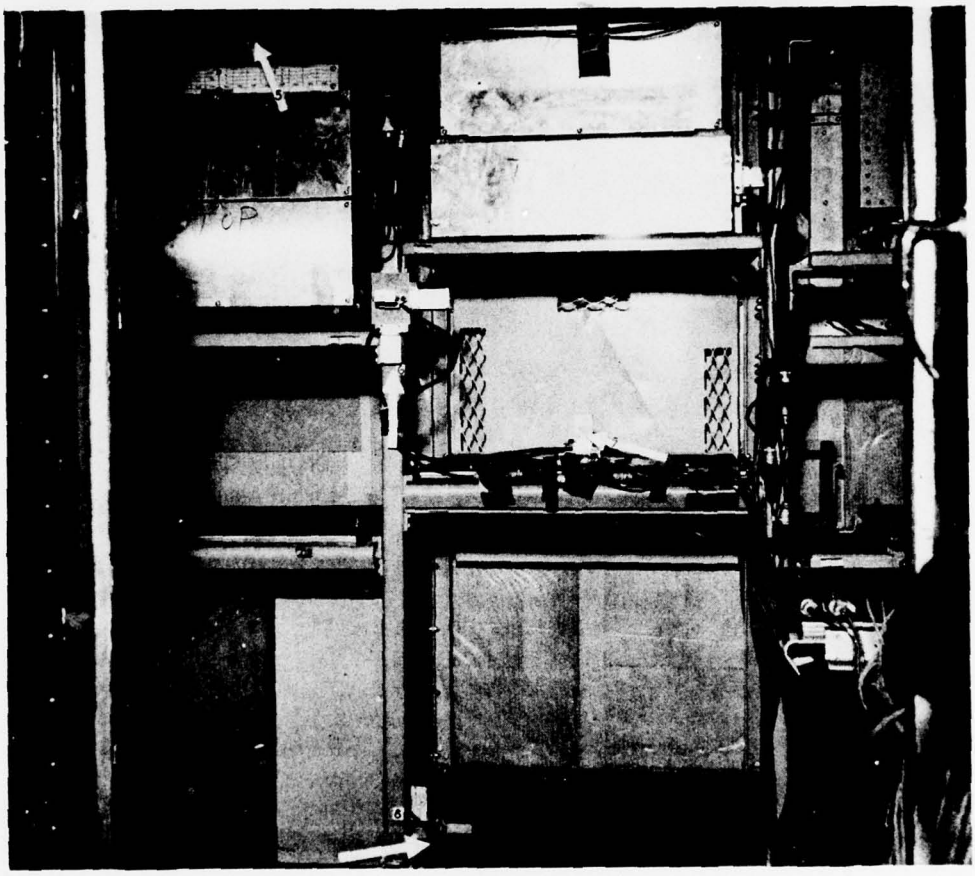


Figure 3: Accelerometers Mounted on: (5) AN/GRC-106; (6) Vertical Support, Left Vertical Rack Member; (7) Teletypewriter TT-76 ( )/GGC; (8) Left Vertical Rack Member, Floor Level.

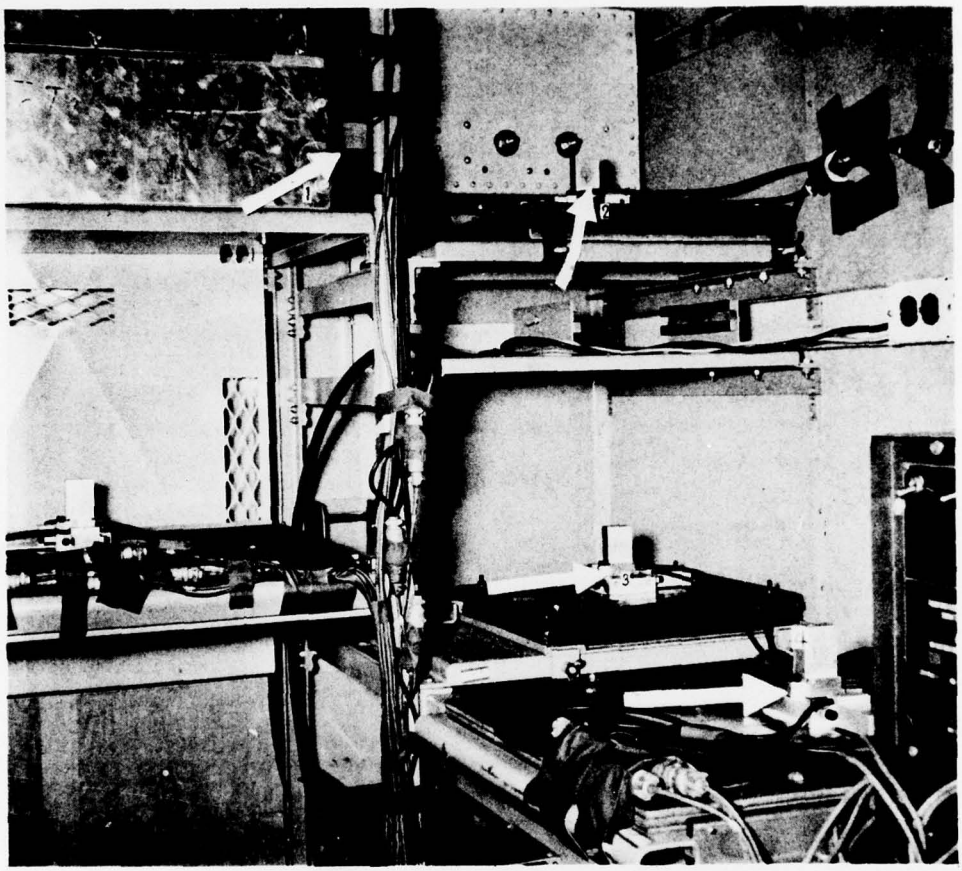


Figure 4: Accelerometers Mounted on: (1) Modem MD-522 ( )/GRC; (2) Dummy Box No. 2; (3) Dummy Box No. 1; (4) Duplex AN/UGC-4.

2.3.2 Method

The shelter was loaded in the manner normally used for shipment on a railroad flatcar (American Railroads Association approved methods). Tests were conducted on a flat, straight stretch of track. An impact car of 165,000 pounds gross weight, traveling at a nominal speed of 9 mph, was impacted against the stationary test car which was coupled to two other cars. One of these cars was loaded to approximately 165,000 pounds gross weight, the other car was unloaded. The buffer cars were stationary with brakes off. Four impacts were performed, two with the shelter positioned longitudinally to the flatcar and two positioned laterally.

For regulation of speed, the locomotive trailed a calibrated fifth wheel; the locomotive engineer used the speedometer as a reference. The actual impact speeds were determined by measuring the time required for the impact car to travel the last 50 feet prior to striking the buffer load. Actual speeds are tabulated in Table III.

Table III. Rail Hump Impact Speeds

Hump No.	Object Speed, mph	Direction	Impact Speed, mph
1	9	Impact into rear of shelter (longitudinal)	9.0
2	9	Impact into rear of shelter (longitudinal)	9.2
3	9	Impact into right side of shelter (lateral)	9.2
4	9	Impact into right side of shelter (lateral)	8.5

During railroad humping tests, dummy boxes 1 and 2 were removed from the shelter. Two of the accelerometers removed from these locations were positioned on the flatcar floor to measure the vertical and longitudinal input at the shelter base (Figure 5). At the conclusion of the longitudinal hump tests (tests 1 and 2), the teletypewriter TT-76 ( )/GRC and the duplex AN/GRC-4 were removed from the shelter. The three transducers mounted on the

duplex AN/GRC-4 unit were relocated on the sponson at the mounting base.

Recordings of the shock duration and amplitude were made during the test. After the test, the interior and exterior of the shelter was inspected to determine evidence of breakage, deformation, or loosening of parts and structural members.

Figures 5 and 6 are general views of the railroad hump test setup and a three-quarter view of the shelter tiedown.

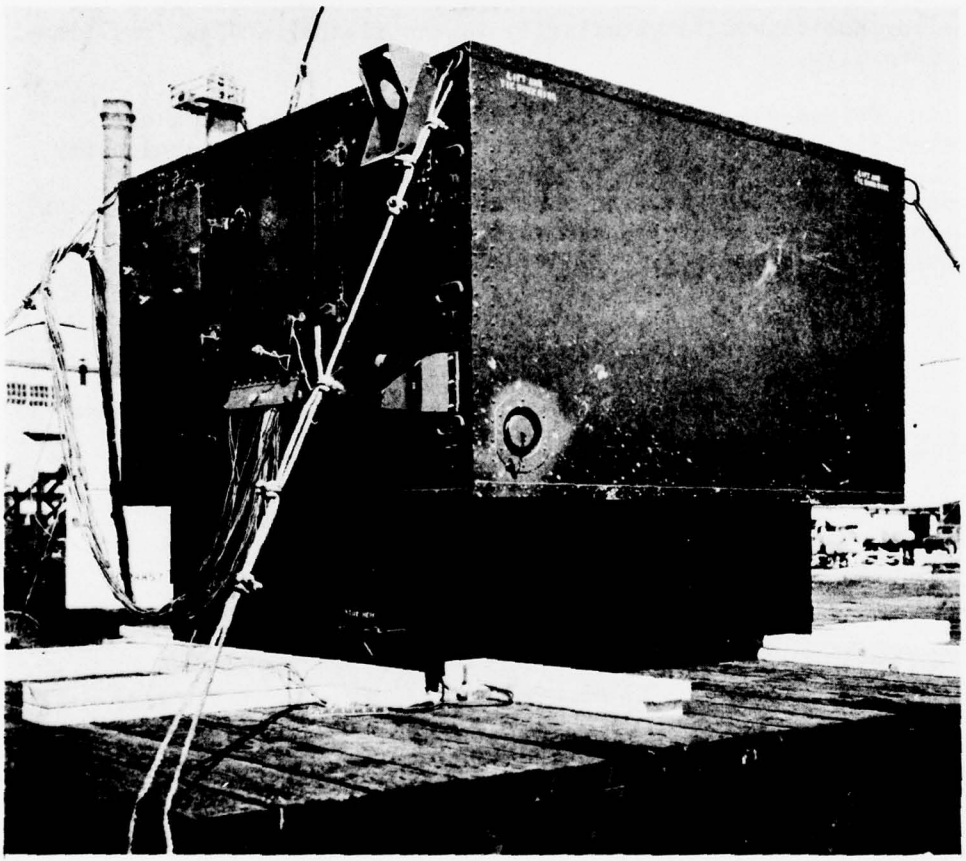


Figure 5: Accelerometers Mounted on Railroad Car Floor Adjacent to Blocking and Over-all View of Shelter Tiedown.

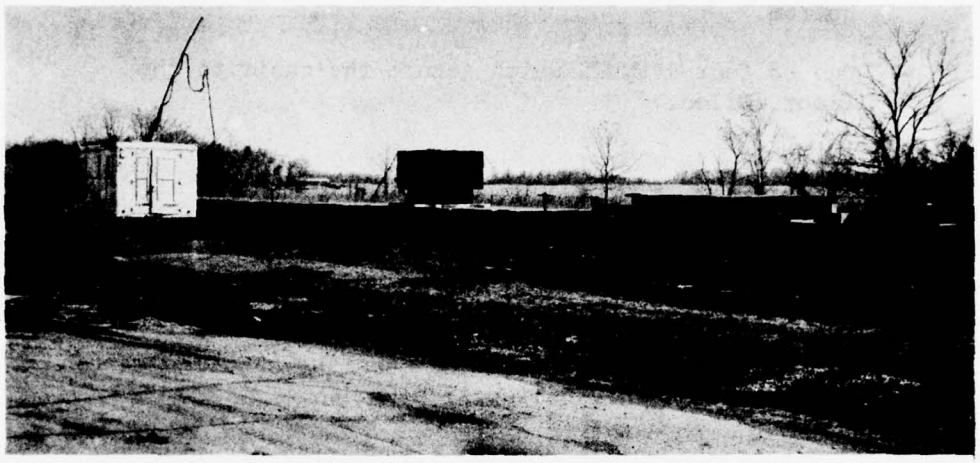


Figure 6: View of Railroad Hump Test Setup.

2.3.3 Results

Oscillographic record sections showing the response of the test item to rail humping (impacts) at a speed of 9.2 mph are included in Appendix B.

There was no apparent damage to the shelter blocking as a result of impacts up to 9.2 mph; however, the equipment-mounting fixtures within the shelter were inadequate in some instances. A list of deficiencies noted after each impact follows:

a. Impact No. 1.

1) The TT-76/GGC teletypewriter and two AN/UGC-4 mounting-base guides broke at point where the locking pin goes through on each of the three mounting bases. The left-hand AN/UGC-4 shelf was removed; the other two shelves were reinforced by means of C-clamps to obtain additional data.

2) A vertical structural member of the shelter appeared to be deformed at the point where the mounting shelf for the AN/GRC-106 was attached. Verification could not be made because the member was hidden by the internal and external skin of the shelter.

3) The safe door appeared to be sprung slightly at the bottom.

4) One of four RIVNUTS which secure the chair to the floor failed.

b. Impact No. 2.

1) At the AN/GRC-106 system, the vertical member of the shelter appeared to have additional deformation.

c. Impact No. 3.

1) At the AN/GRC-106 system, the mounting shelf began to separate from the shelter side wall.

2) A slight deformation of the air ducting occurred as a result of duct displacement.

3) The forward motor generator set shifted in the mounting fixture. This was attributed to loosening of tiedown bolts; no damage occurred.

d. Impact No. 4.

1) At the AN/GRC-106 system, the mounting shelf broke loose from the shelter side wall and bent slightly at center rear of shelf. The vertical support of the shelter appeared fractured.

2) The Modem MD-522 ( ) GRC support shelf impacted and bent both sides of the exhaust plenum. Slight bending of Modem shelf occurred at the center rear area.

3) Rivets holding the safe mounting fixture pulled loose from shelf supports on one side.

2.3.4 Analysis

Data obtained from rail hump testing are primarily shock in nature and as such can be best described by a time-history (oscillogram) presentation. Time-history records in this report have been reproduced using 600- and 60-cps galvanometers. The 60-cycle galvanometers effectively filtered out the high-frequency local resonances caused mainly by ringing of the parent metal and aid the reader in determining the underlying shock impulses.

SECTION 3. APPENDICES

APPENDIX A - TEST DIRECTIVE

AMSTE-EL (6 Apr 64) 1st Ind
SUBJECT: Test Directive, Engineer Design (Road) Test, Category II of Radio Teletypewriter Set AN/GRC-122, USATECOM Project Number 6-4-3112-05

Headquarters, U. S. Army Test & Evaluation Command, Aberdeen Proving Ground, Maryland 21005 10 APR 1964

TO: Commanding Officer, Aberdeen Proving Ground, ATTN: STEAP-DS-LU, Aberdeen Proving Ground, Maryland 21005

1. References:

a. Telephone conversation between Mr Harry Shore, USAELRDL and Mr Stanley, HQ, USATECOM, 7 Apr 64.

b. Telephone conversation between Mr P McKay, APG, D&PS and Mr Stanley, HQ, USATECOM, 7 Apr 64.

2. You are directed to conduct an Engineer Design (Road) Test on Radio Teletypewriter Set AN/GRC-122 as requested by USAELRDL in the basic letter. This task has been assigned USATECOM Project Number 6-4-3112-05 and has been entered into TEAMS.

3. This is a Category II test being conducted as a service to the requesting agency. The report of test will be forwarded to the requesting agency with an information copy to this headquarters, USAEPG, and USAAESWBd.

4. Funds in the amount of $5,000 are available under Service Order Nr FY-64-95178 to D&PS as discussed with Mr McKay, ref 1b, and Mr Shore, ref 1a.

5. Mr H Shore of USAELRDL stated that additional funds in the amount of $2,500 will be transferred to APG, D&PS to complete testing, ref 1a.

6. Request that Development and Proof Services ascertain that the additional funding has been made available prior to accomplishment of those test phases which are not funded by the initial Service Order Nr FY-64-95178.

FOR THE COMMANDER:

1Incl
TEAMS Forms

ROBERT A. BAILEY
1st Lt AGC
Asst Admin Officer

Copies furnished:
CG, USAEPG, ATTN: STEEP-O
Pres, USAAESW Bd, ATTN: STEBF-CE

HEADQUARTERS
U. S. ARMY ELECTRONICS RESEARCH AND DEVELOPMENT LABORATORIES
FORT MONMOUTH, NEW JERSEY 07703

IN REPLY REFER TO:
[redacted]
AMSEL-RD-GTF

6 APR 1964

SUBJECT: Munson Road and Rail Humping Tests on Dummy Loaded Radio Teletypewriter Set AN/GRC-122

TO: Commanding General
U.S. Army Test and Evaluation Command
ATTN: AMSTE-EL
Aberdeen Proving Ground
Maryland

1. Reference is made to telephone conversation on 26 March between Mr. H. Cline, STEAP-DS-LU, and Mr. H. Kreisler, USAELRDL, and to visit with your Mr. R. Lee on 1 April, regarding a request to conduct shock and vibration tests on the subject equipment.

2. The tests required are engineering design tests and require the use of instrumentation to record peak g versus frequency at critical points in the shelter. The placement of the accelerometers will be indicated by the USAELRDL engineer who will accompany the equipment, make visual observations, monitor and direct the tests. Development and Proof Services will be required to use their instrumentation, make their recordings, analyze the results and provide USAELRDL with a report of these results.

3. A transfer of funds in the amount of $5000, based on preliminary cost estimate issued by Mr. Cline, was made on 1 April under Service Order No. FY-64 95178.

4. It was agreed that the equipment would arrive at APG on 6 April and that efforts would be made to start the tests on or about 7 April.

5. A copy of the test procedure was left with Mr. R. Lee on 1 April.

6. For any questions requiring further coordination on this task, your contact at USAELRDL is Mr. H. Kreisler, AMSEL-RD-GTF, extension 51838.

6 APR 1964

AMSEL-RD-GTF
SUBJECT: Munson Road and Rail Humping Tests on Dummy Loaded Radio Teletypewriter Set AN/GRC-122

7. It is requested that approval for conducting the above tests be granted.

8. Use of overtime not to exceed 40 hours is authorized to assure the most efficient accomplishment of this task.

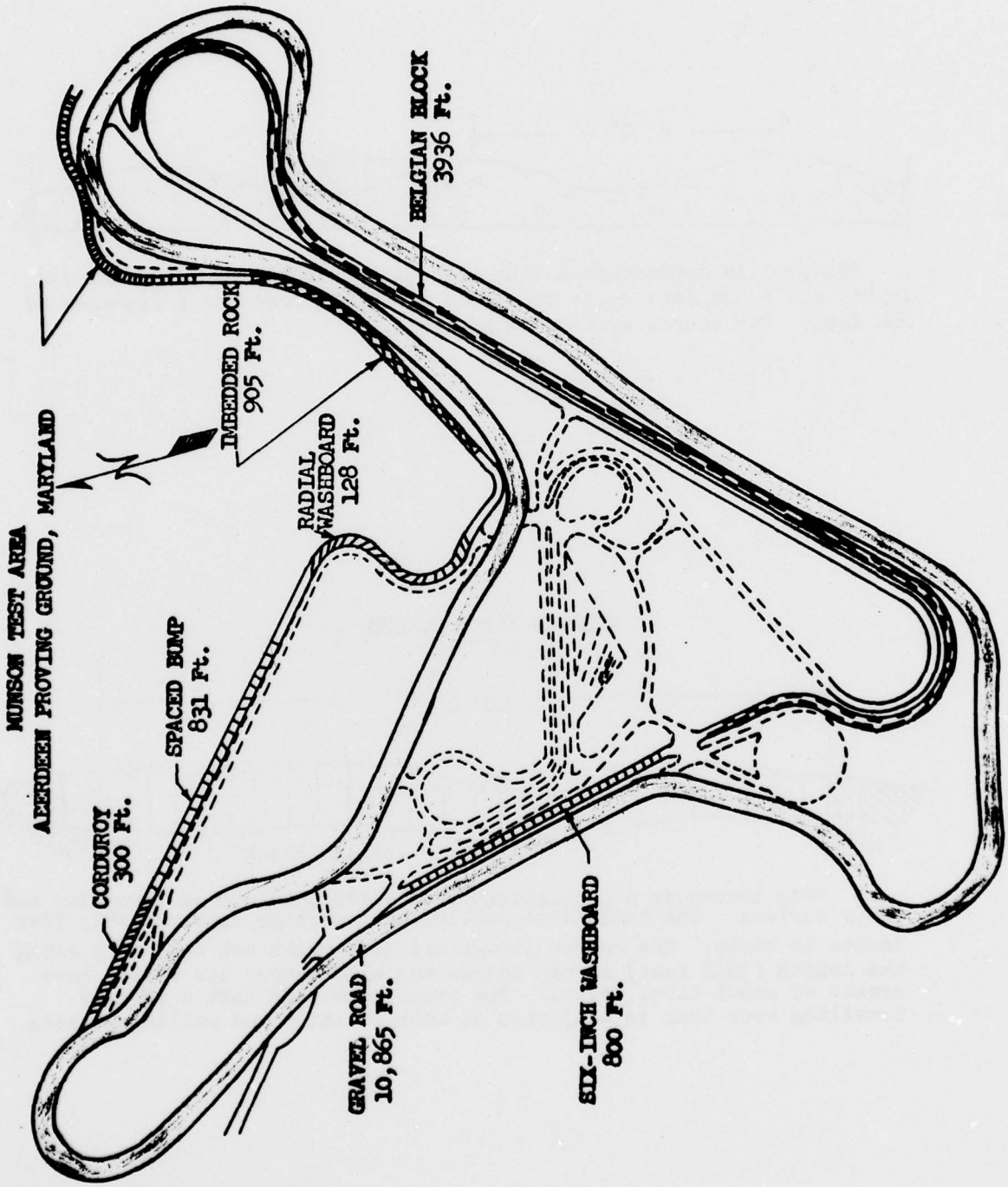
FOR THE COMMANDER:

Robert M. Greenwood

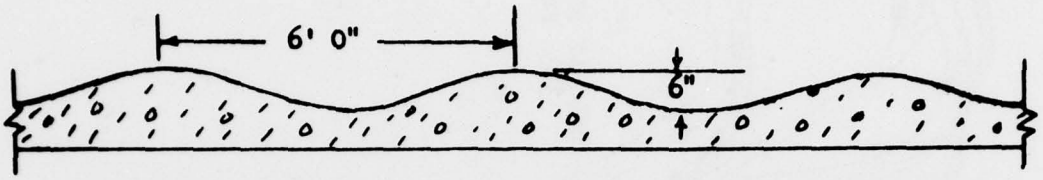
ROBERT M. GREENWOOD
2d Lt, SigC
Asst Adjutant

Copy furnished:
CO, D&PS
ATTN: STEAP-DS-LU
APG, Md.

APPENDIX B - TEST DATA

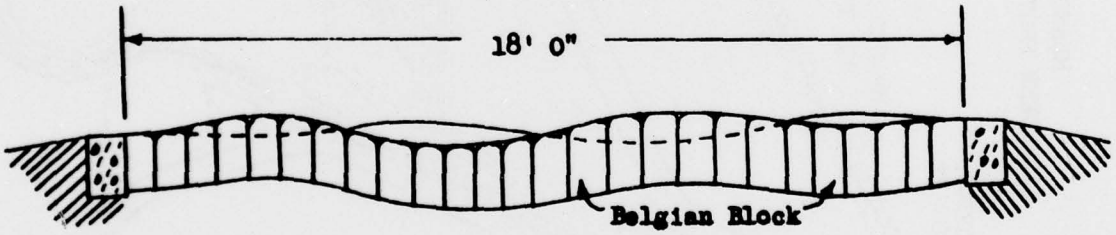


SIX-INCH WASHBOARD COURSE



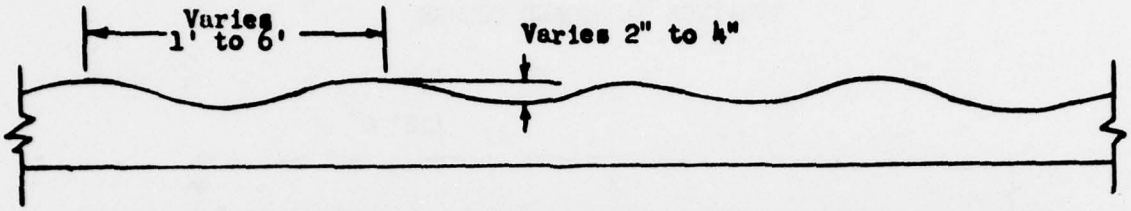
The profile approaches a sine wave with a double amplitude of six inches and a complete cycle occurring every six feet for a distance of 800 feet. The course surface is concrete.

BELGIAN BLOCK COURSE



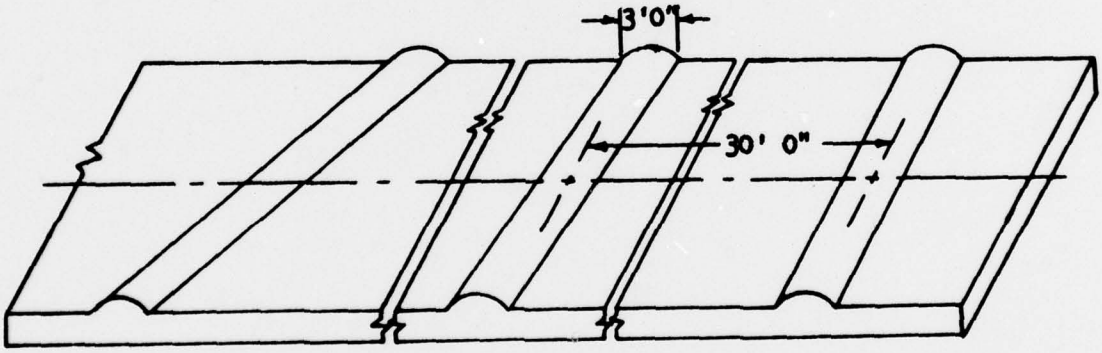
This course is a cobblestone road which provides an irregular and bumpy surface. The individual cobblestones average approximately five inches in width. The course irregularities, which not only vary along the length (3936 feet) of the course but also across its width, have crests of about three inches. The crests are such that a vehicle traveling over them is subjected to both pitching and rolling motions.

RADIAL WASHBOARD COURSE

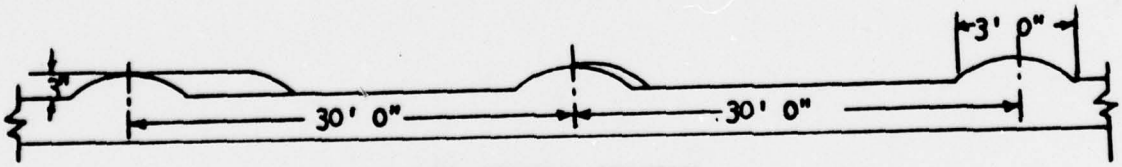


Two 90 degrees radial turns make up the Radial Washboard Course along with symmetrical bumps which vary from two to four inches in height and from one to six feet from crest to crest. The course is 128 feet long and 20 feet wide.

SPACED BUMP COURSE



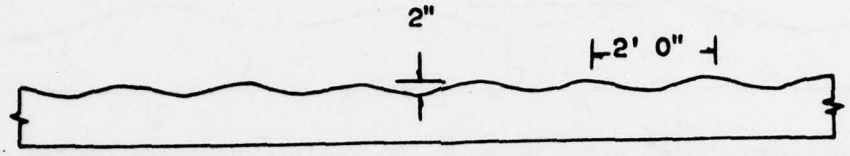
ISOMETRIC VIEW



LONGITUDINAL SECTION

This course consists of a series of rounded bumps three inches high by three feet wide spaced at intervals of 30 feet along the centerline of the course. The bumps make the following angles with respect to the centerline of the course: 90°, 90°, 67°, 52°, 90°, 90°, 113°, 128°, 90°, 90°, this sequence continues for a total of twenty six bumps or three cycles for a total of 831 feet.

TWO-INCH WASHBOARD COURSE



The profile approaches a sine wave with a double amplitude of two inches and a complete cycle occurring every two feet to a distance of approximately 300 feet. The course surface is concrete.

CEEB Form 2587-(R), 24 Jul 62

VEHICLE Truck, Cargo, 3/4 Ton, 4x4, M37 COURSE Six-Inch Washboard SPEED 5 MPH

CARGO Shelter Containing AN/GRC-122 System RECORD 15 SECONDS WEIGHT _____ POUNDS

REMARKS All Electronic Components Simulated DATE OF TEST 15 April 1964 TIRE PRESSURE _____ PSI

AMPLITUDE DISTRIBUTION ANALYSIS

CHAN.	LOCATION	PLANE	ACCELERATION - g			MAJOR FREQUENCIES[a] - cps			
			σ	1% Lev.	Crest				
1	AN/GRC-106 (Simulated)	Vert	.36	.94	1.7		2.5, 17		
2		Trans	.12	.31	.52		28, 22, 3		
3		Long	.39	.95	1.4		2.5, 6, 22		
4	Left Vertical Rack Member, Adjacent to AN/GRC-106	Vert	.33	.75	.98		3		
5		Trans	.08	.23	.63		2.5, 22,	32	
6		Long	.30	.70	.93		5, 20		
7	Left Vertical Rack Member, Floor Level	Vert	.34	.86	1.3		2.5		
8		Trans	.05	.14	.37		3.5, 10,	18	
9		Long	.22	.50	.67		2.5, 8,	14, 20	
10	MODEM MD-522 ( )/GRC, (Simulated)	Vert	.35	.86	1.3		2.5, 18,	34	
11		Trans	.08	.23	.59		2.5, 33,	22	
12		Long	.30	.60	.72		3, 6.5,	20	
13	Teletypewriter TT-76 ( ), GGC, (Simulated)	Vert	.32	.77	1.1		3, 19, 16		
14		Trans	.07	.20	.64		4.5, 3		
15		Long	.28	.73	1.2		3, 28		
16	Dummy Box 1 (Simulated)	Vert	.32	.74	1.0		2.5, 6,	20, 40	
17		Trans	.07	.23	.71		2.5, 31.5,	52	
18		Long	.29	.68	.93		3, 7		
19	Dummy Box 2 (Simulated)	Vert	.33	.80	1.1		3, 16.5,	45	
20		Trans	.07	.20	.51		3.5, 53,	65, 20	
21		Long	.29	.71	1.1		3, 10, 79		
22	Duplex AN/UGC-4 (Simulated)	Vert	.41	.97	1.3		3.5, 21,	28	
23		Trans	.07	.18	.36		2.5, 12,	20, 32	
24		Long	.25	.64	1.1		3, 7, 11,	22	

[a] Approximate center frequency of narrow band responses (2.5 to 5 cps wide) which combine to contain the greatest portion of the full spectrum energy.

ORDBG Form 2587-(R), 24 Jul 62

VEHICLE Truck, Cargo, 3/4 Ton, 4x4, M37 COURSE Belgian Block SPEED 20 MPH

CARGO Shelter Containing AN/GRC-122 System RECORD 15 SECONDS WEIGHT _____ POUNDS

REMARKS All Electronic Components Simulated DATE OF TEST 15 April 1964 TIRE PRESSURE _____ PSI

AMPLITUDE DISTRIBUTION ANALYSIS

CHAN.	LOCATION	PLANE	ACCELERATION - g			MAJOR FREQUENCIES[a] - cps		
			σ	1% Lev.	Crest			
1	AN/GRC-106 (Simulated)	Vert	.20	.51	.87	2.5, 7.5,	18, 31	
2		Trans	.21	.52	.76	3, 27.5,	11.5	
3		Long	.38	.94	1.5	5, 18.5,	108	
4	Left Vertical Rack Member, Adjacent to AN/GRC-106	Vert	.15	.40	.79	8.5, 3		
5		Trans	.12	.30	.45	3, 5, 11,	27	
6		Long	.23	.60	1.0	6, 32		
7	Left Vertical Rack Member, Floor Level	Vert	.15	.39	.65	9, 16.5		
8		Trans	.14	.34	.56	3.5, 11,	28	
9		Long	.08	.21	.36	6, 10, 20,	28	
10	MODEM MD-522 ( )/GRC, (Simulated)	Vert	.19	.52	1.0	7, 2.5,	20, 34	
11		Trans	.13	.35	.64	3, 11.5,	6, 32	
12		Long	.26	.66	1.0	6.5, 22,	14	
13	Teletypewriter TT-76 ( ), GGC, (Simulated)	Vert	.23	.57	.84	3, 11.5,	33, 51	
14		Trans	.49	1.2	1.9	6, 2.5,	10	
15		Long	.18	.43	.61	7, 3, 30		
16	Dummy Box 1 (Simulated)	Vert	.22	.58	.98	2.5, 8,	33, 18	
17		Trans	.12	.32	.51	7.5, 30,	3.5	
18		Long	.06	.17	.32	11, 2.5,	16.5, 30	
19	Dummy Box 2 (Simulated)	Vert	.19	.49	.81	3, 7.5,	39	
20		Trans	.12	.31	.51	10, 3, 18,	62.5	
21		Long	.17	.41	.56	7, 2.5,	12, 74	
22	Duplex AN/UGC-4 (Simulated)	Vert	.20	.47	.68	2, 8,	24	
23		Trans	.12	.34	.75	9, 3.5,	12, 25	
24		Long	.16	.42	.79	5, 2, 9,	18, 47	

[a] Approximate center frequency of narrow band responses (2.5 to 5 cps wide) which combine to contain the greatest portion of the full spectrum energy.

ORDBG Form 2587-(R), 24 Jul 62

VEHICLE Truck, Cargo, 3/4 Ton, 4x4, M37 COURSE Spaced Bump SPEED 20 MPH

CARGO Shelter Containing AN/GRC-122 System RECORD 15 SECONDS WEIGHT _____ POUNDS

REMARKS All Electronic Components Simulated DATE OF TEST 15 April 1964 TIRE PRESSURE _____ PSI

AMPLITUDE DISTRIBUTION ANALYSIS

CHAN.	LOCATION	PLANE	ACCELERATION - g			MAJOR FREQUENCIES[a] - cps			
			σ	1% Lev.	Crest				
1	AN/GRC-106 (Simulated)	Vert	.28	.87	2.4		6, 30,	20	
2		Trans	.16	.45	1.0		5		
3		Long	.60	1.6	3.1		6, 19		
4	Left Vertical Rack Member, Adjacent to AN/GRC-106	Vert	.23	.65	1.4		7, 3		
5		Trans	.17	.49	1.2		6, 3		
6		Long	.49	1.2	1.9		30, 7		
7	Left Vertical Rack Member, Floor Level	Vert	.27	.76	1.9		5, 7, 4		
8		Trans	.12	.40	1.5		10, 3, 7		
9		Long	.16	.50	1.4		7.		
10	MODEM MD-522 ( )/GRC, (Simulated)	Vert	.28	.87	2.8		7, 20, 3,	37	
11		Trans	.15	.43	.89		8, 32,	4	
12		Long	.39	1.1	2.0		5, 20		
13	Teletypewriter TT-76 ( ), GOC, (Simulated)	Vert	.53	1.4	2.3		7, 31, 21,	50	
14		Trans	.57	1.5	2.5		6		
15		Long	.23	—	3.3		5		
16	Dummy Box 1 (Simulated)	Vert	.20	.54	1.0		3, 7, 5		
17		Trans	.10	.29	.70		7, 27		
18		Long	.08	.23	.66		7		
19	Dummy Box 2 (Simulated)	Vert	.25	.66	1.2		8, 4, 43		
20		Trans	.14	.38	.73		7, 60		
21		Long	.23	.66	1.5		5		
22	Duplex AN/UGC-4 (Simulated)	Vert	.20	.56	1.3		5		
23		Trans	.12	.40	1.4		9, 3, 7		
24		Long	.21	.57	1.1		6		

[a] Approximate center frequency of narrow band responses (2.5 to 5 cps wide) which combine to contain the greatest portion of the full spectrum energy.

ORDBG Form 2587-(R), 24 Jul 62

VEHICLE Truck, Cargo, 3/4 Ton, 4x4, M37 COURSE Radial Washboard SPEED 15 MPH

CARGO Shelter Containing AN/GRC-122 System RECORD 15 SECONDS WEIGHT _____ POUNDS

REMARKS All Electronic Components Simulated DATE OF TEST 15 April 1964 TIRE PRESSURE 40 PSI

AMPLITUDE DISTRIBUTION ANALYSIS

CHAN.	LOCATION	PLANE	ACCELERATION - g			MAJOR FREQUENCIES[a] - cps
			σ	1% Lev.	Crest	
1	AN/GRC-106 (Simulated)	Vert	.29	.81	1.7	6, 11, 32
2		Trans	.15	.36	.51	7
3		Long	.47	1.3	2.2	7
4	Left Vertical Rack Member, Adjacent to AN/GRC-106	Vert	.17	.49	.99	5
5		Trans	.11	.34	.88	5
6		Long	.45	1.2	1.9	7.5, 27.5
7	Left Vertical Rack Member, Floor Level	Vert	.18	.51	1.3	6
8		Trans	.18	.45	.74	4, 9, 11
9		Long	.11	.34	.99	7, 12, 18
10	MODEM MD-522 ( )/GRC, (Simulated)	Vert	.22	.61	1.4	4
11		Trans	.16	.44	.89	7.5, 33
12		Long	.32	.83	1.4	7
13	Teletypewriter TT-76 ( ) GGC, (Simulated)	Vert	.54	1.4	2.3	7.5, 11
14		Trans	.50	1.2	1.8	7
15		Long	.23	.62	1.2	7
16	Dummy Box 1 (Simulated)	Vert	.22	.58	1.0	5, 41
17		Trans	.07	.19	.36	7, 28
18		Long	.09	.25	.47	9, 5
19	Dummy Box 2 (Simulated)	Vert	.21	.58	1.2	5
20		Trans	.16	.43	.73	5, 9
21		Long	.21	.58	1.1	7
22	Duplex AN/UGC-4 (Simulated)	Vert	.20	.58	1.3	4
23		Trans	.16	.53	2.0	5
24		Long	.19	.48	.74	6

[a] Approximate center frequency of narrow band responses (2.5 to 5 cps wide) which combine to contain the greatest portion of the full spectrum energy.

ORDBG Form 2587-(R), 24 Jul 62

VEHICLE Truck, Cargo, 3/4 Ton, 4x4, M37 COURSE Two-Inch Washboard SPEED 10 MPH

CARGO Shelter Containing AN/GRC-122 System RECORD 15 SECONDS WEIGHT _____ POUNDS

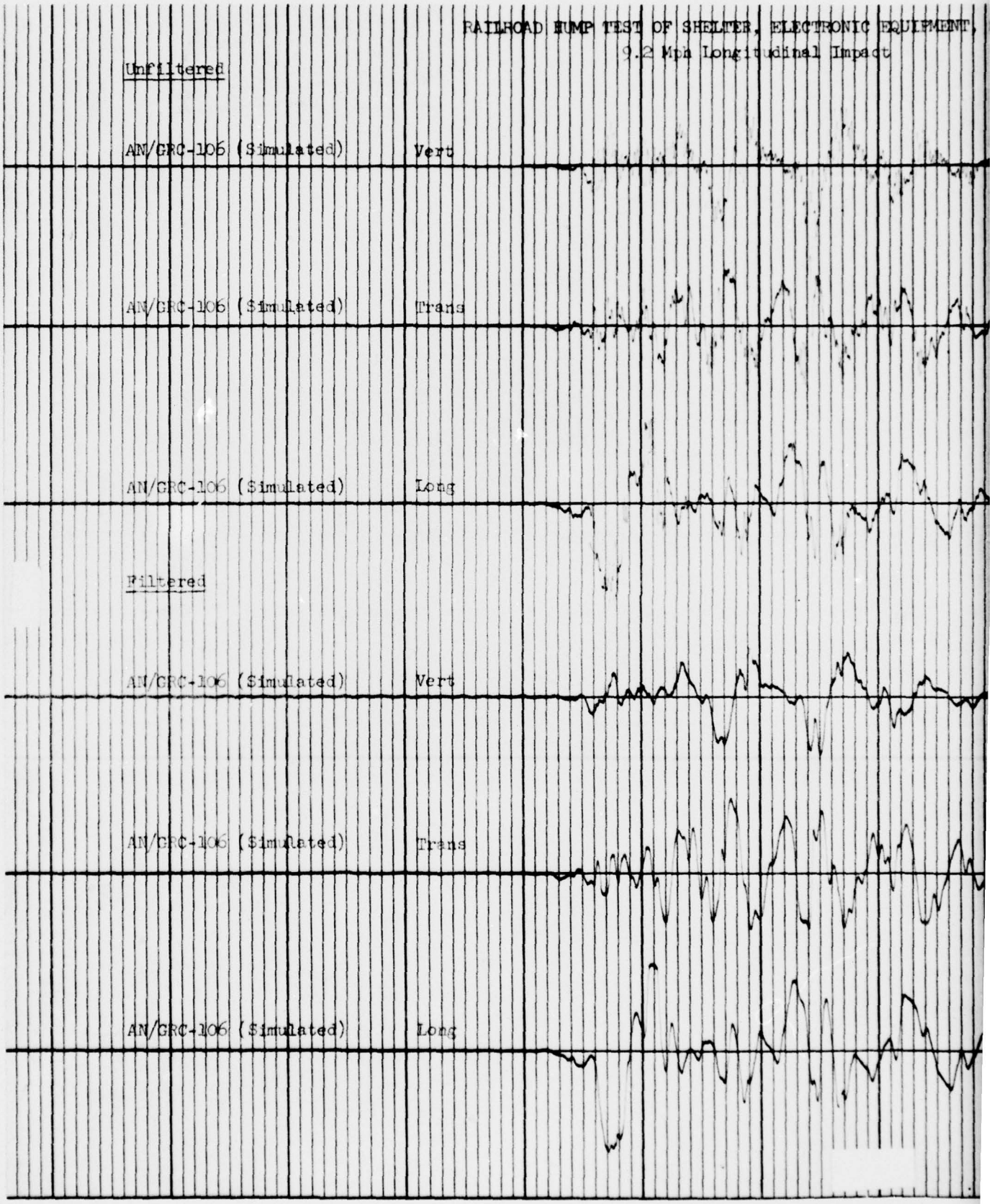
REMARKS All Electronic Components Simulated DATE OF TEST 15 April 1964 TIRE PRESSURE _____ PSI

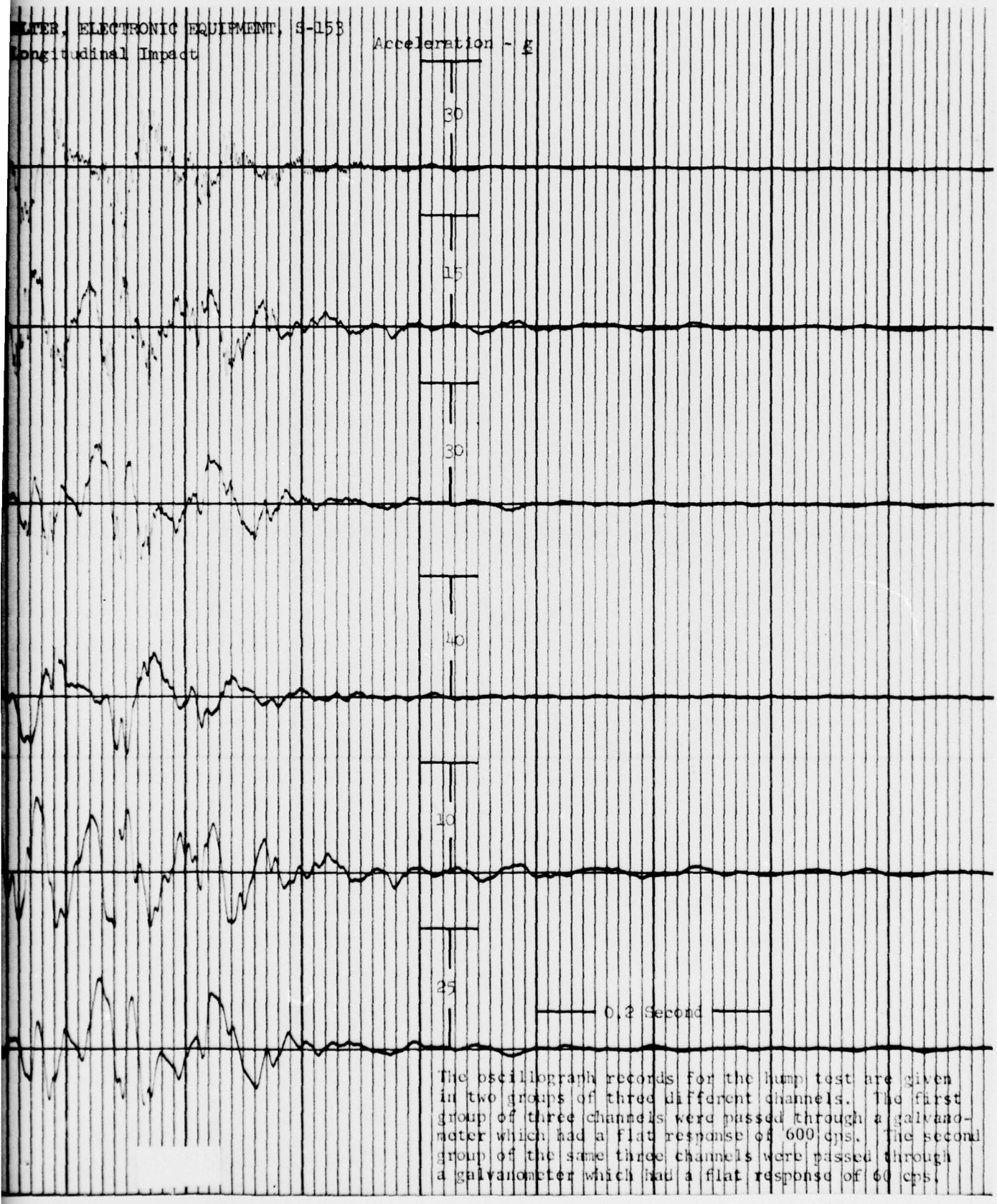
AMPLITUDE DISTRIBUTION ANALYSIS

CHAN.	LOCATION	PLANE	ACCELERATION - g			MAJOR FREQUENCIES[a] - cps
			σ	1% Lev.	Crest	
1	AN/GRC-106 (Simulated)	Vert	.53	1.3	1.7	8, 32, 16, 24
2		Trans	.19	.52	1.0	8, 32, 16
3		Long	.73	1.7	2.3	8, 16, 24, 32
4	Left Vertical Rack Member, Adjacent to AN/GRC-106	Vert	.35	.89	1.5	8, 24, 16
5		Trans	.23	.58	.90	8, 16, 24, 32
6		Long	.94	2.4	3.9	8, 32, 24, 16
7	Left Vertical Rack Member, Floor Level	Vert	.37	.91	1.3	8, 24, 16
8		Trans	.30	.81	1.5	8, 16, 24, 32
9		Long	.25	.63	1.0	8, 16, 32
10	MODEM MD-522 ( )/GRC, (Simulated)	Vert	.46	1.2	1.9	8, 32, 16
11		Trans	.33	1.2	1.9	8, 32
12		Long	.35	.88	1.4	8, 16, 24
13	Teletypewriter TT-76 ( ), GGC, (Simulated)	Vert	.76	2.0	3.4	8, 32, 16, 24, 48
14		Trans	.31	.68	.91	8, 16, 32, 24
15		Long	.27	.69	1.2	8, 16, 32
16	Dummy Box 1 (Simulated)	Vert	.53	1.3	2.0	8, 32, 37, 16, 24
17		Trans	.22	.52	.72	8, 32, 24, 16
18		Long	.32	.80	1.3	8, 16, 32, 37
19	Dummy Box 2 (Simulated)	Vert	.20	.60	1.6	8, 16, 48, 32, 24
20		Trans	.30	.72	1.0	8, 16, 32
21		Long	.27	.67	1.1	8, 16,
22	Duplex AN/UGC-4 (Simulated)	Vert	.40	.96	1.4	8, 24, 16
23		Trans	.66	1.6	2.5	8, 16, 24
24		Long	.27	.69	1.1	8, 16, 40, 32, 24

[a] Approximate center frequency of narrow band responses (2.5 to 5 cps wide) which combine to contain the greatest portion of the full spectrum energy.

RAILROAD BUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT,
9.2 Mph Longitudinal Impact



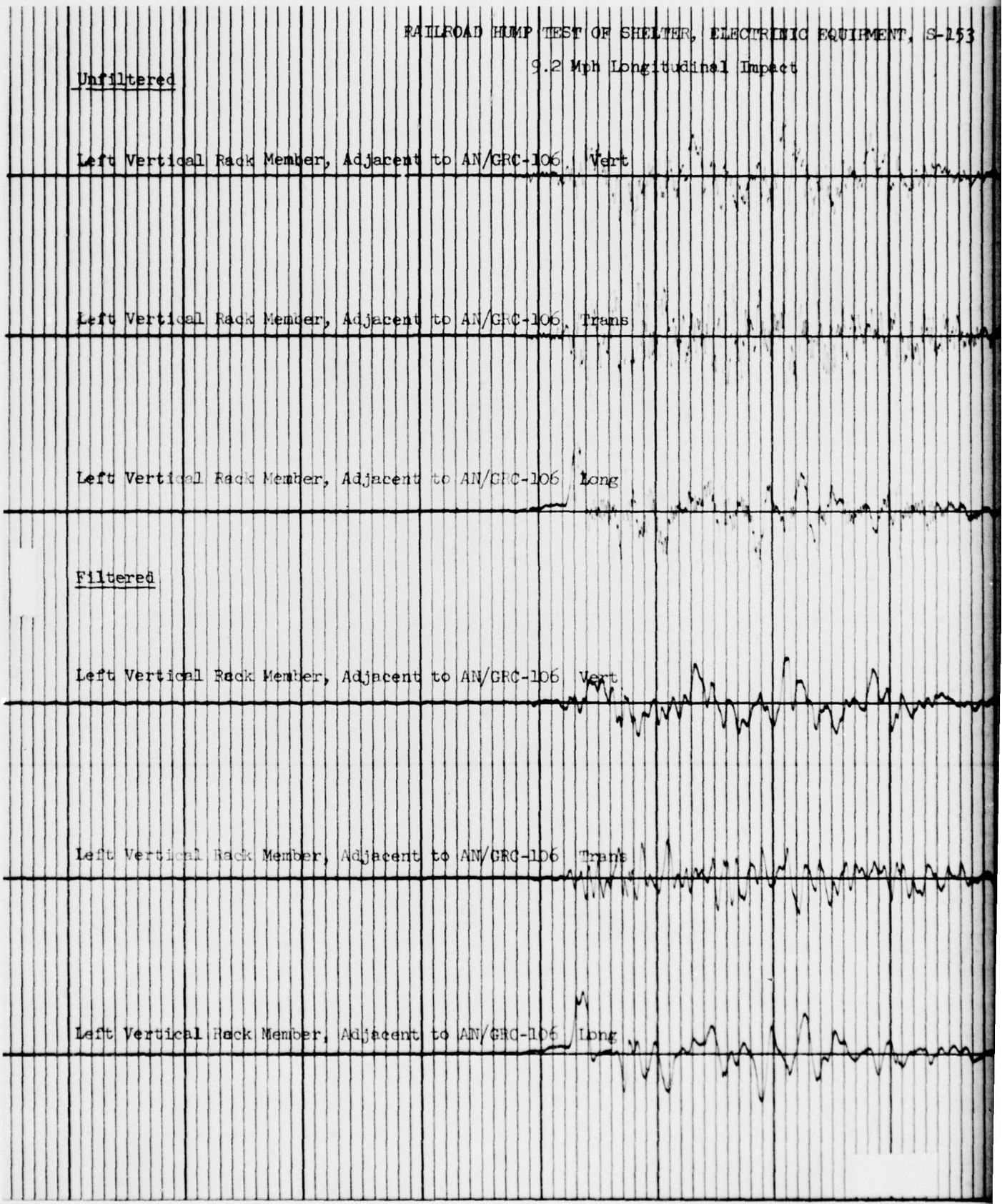


The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

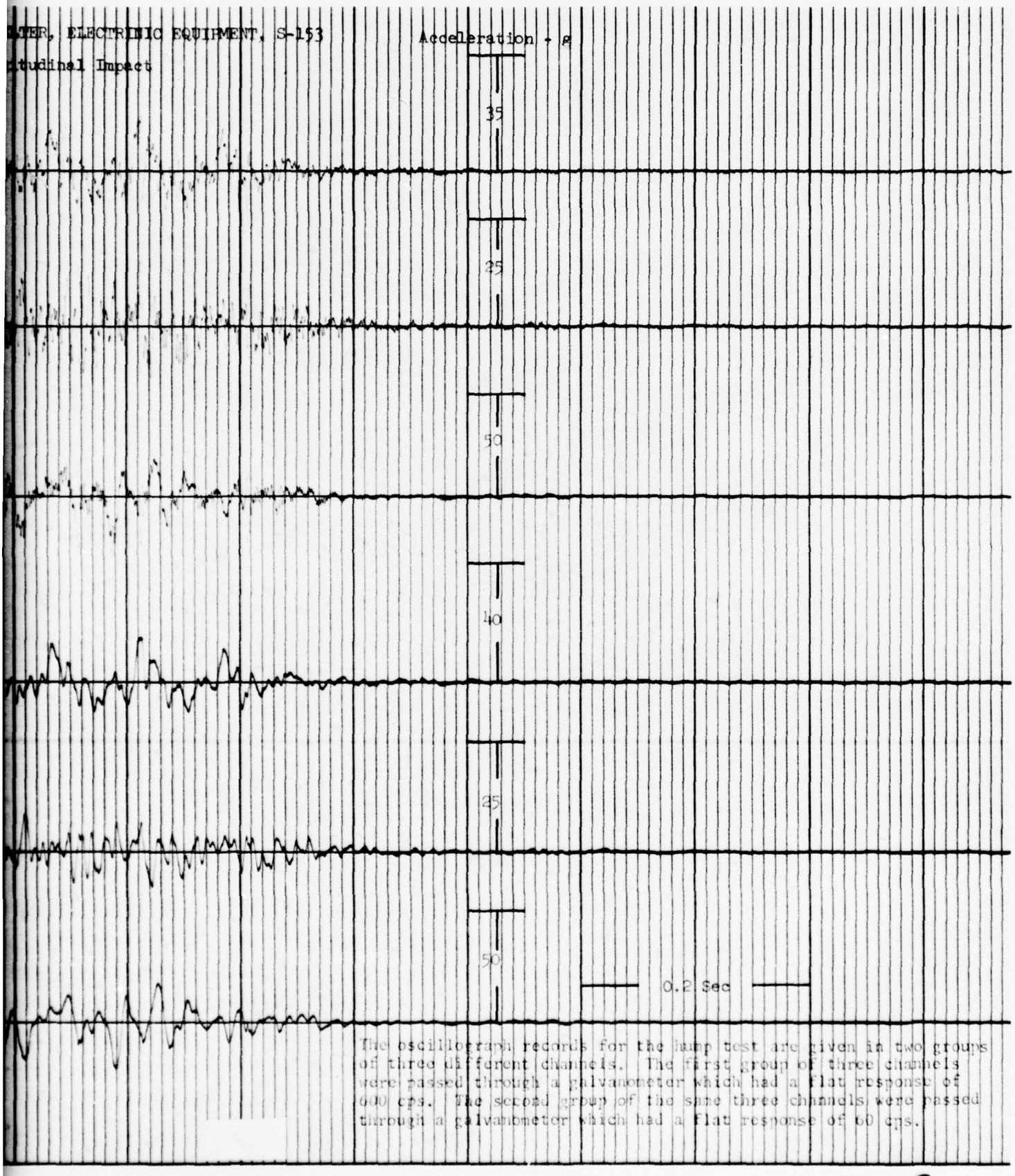
2

RAILROAD HUMP TEST OF SHELTER, ELECTRINIC EQUIPMENT, S-153

9.2 Mph Longitudinal Impact

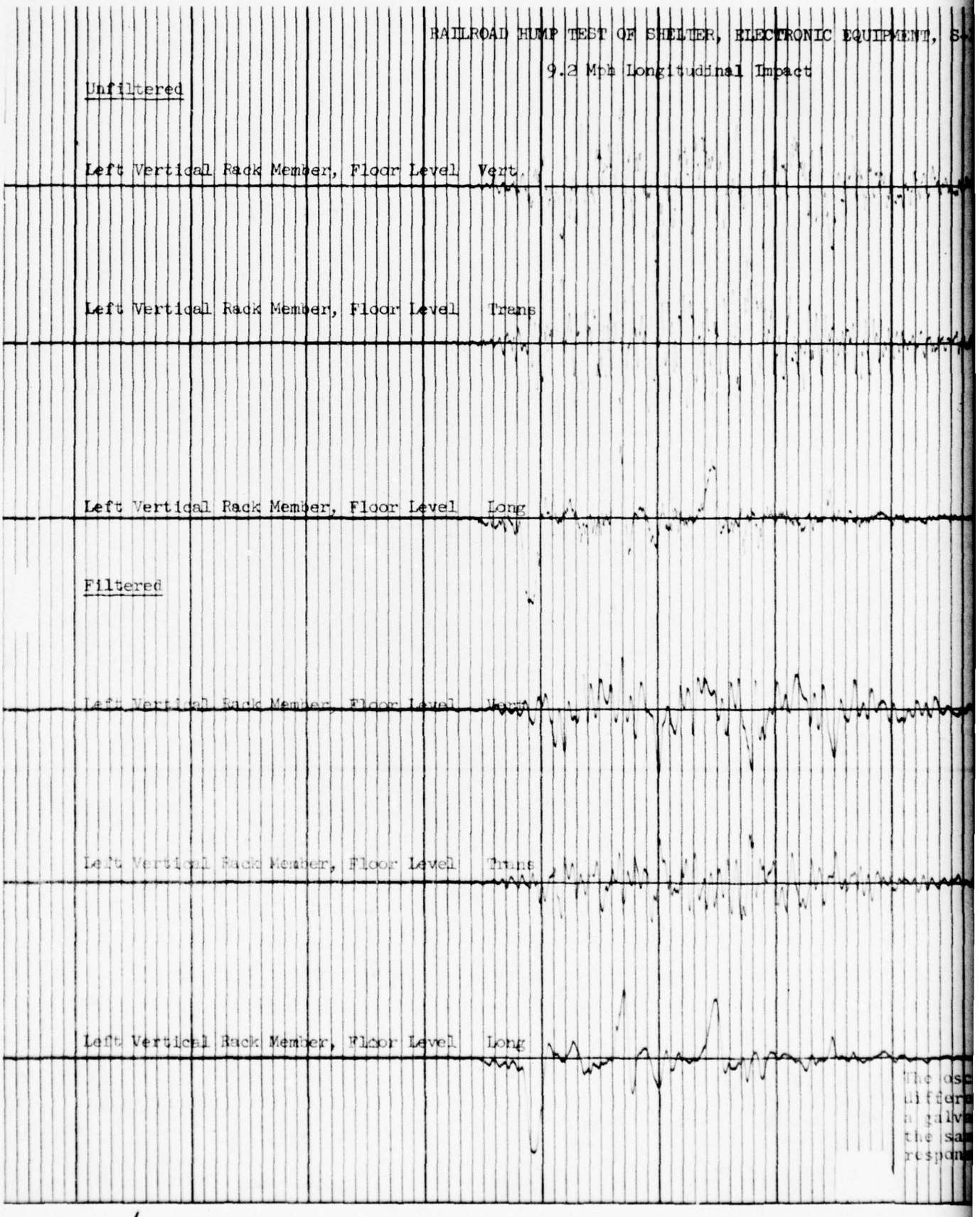


/



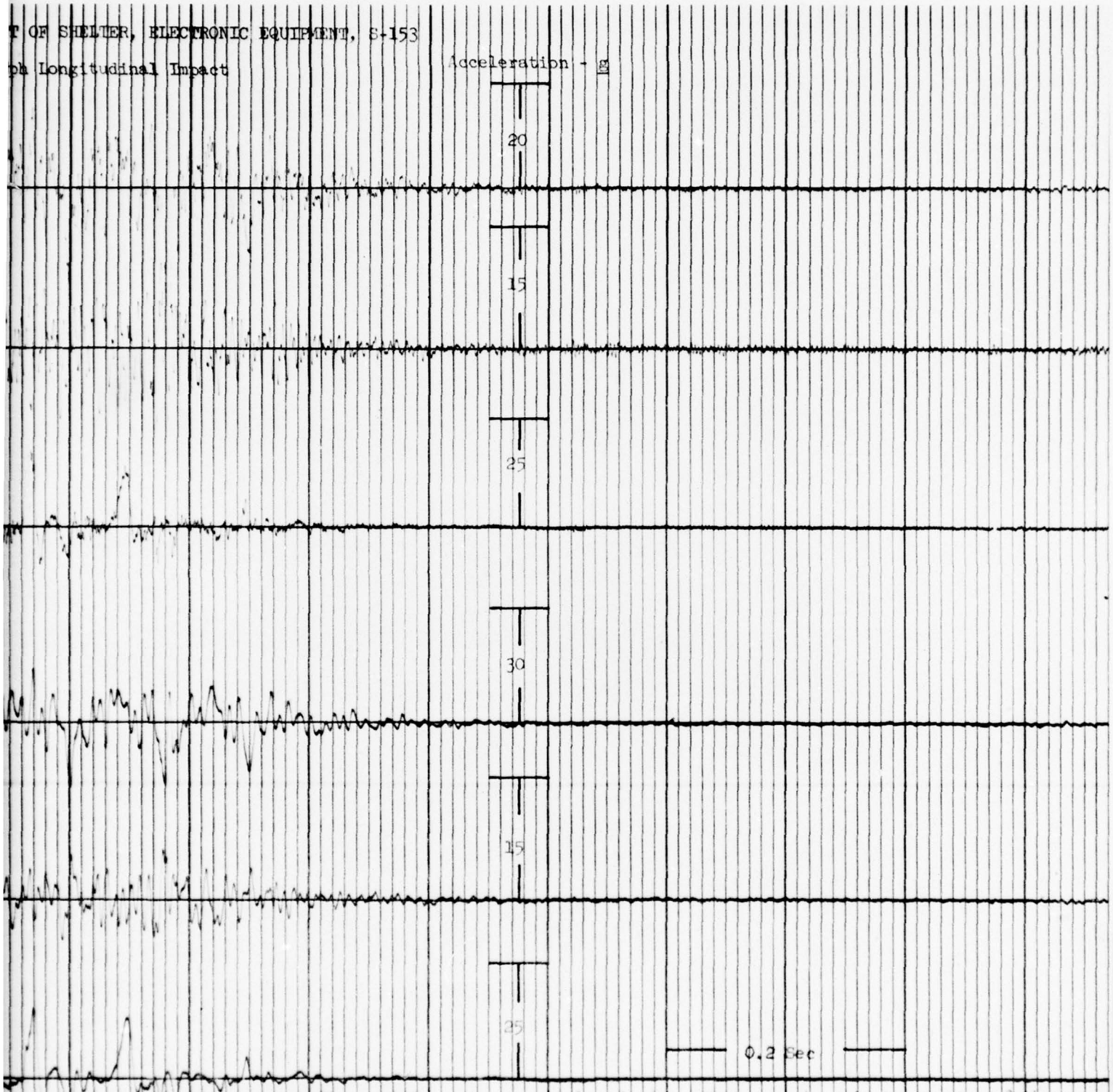
The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

2


RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-
9.2 Mph Longitudinal Impact
Unfiltered
Left Vertical Rack Member, Floor Level Vert.
Left Vertical Rack Member, Floor Level Trans
Left Vertical Rack Member, Floor Level Long
Filtered
Left Vertical Rack Member, Floor Level Vert.
Left Vertical Rack Member, Floor Level Trans
Left Vertical Rack Member, Floor Level Long

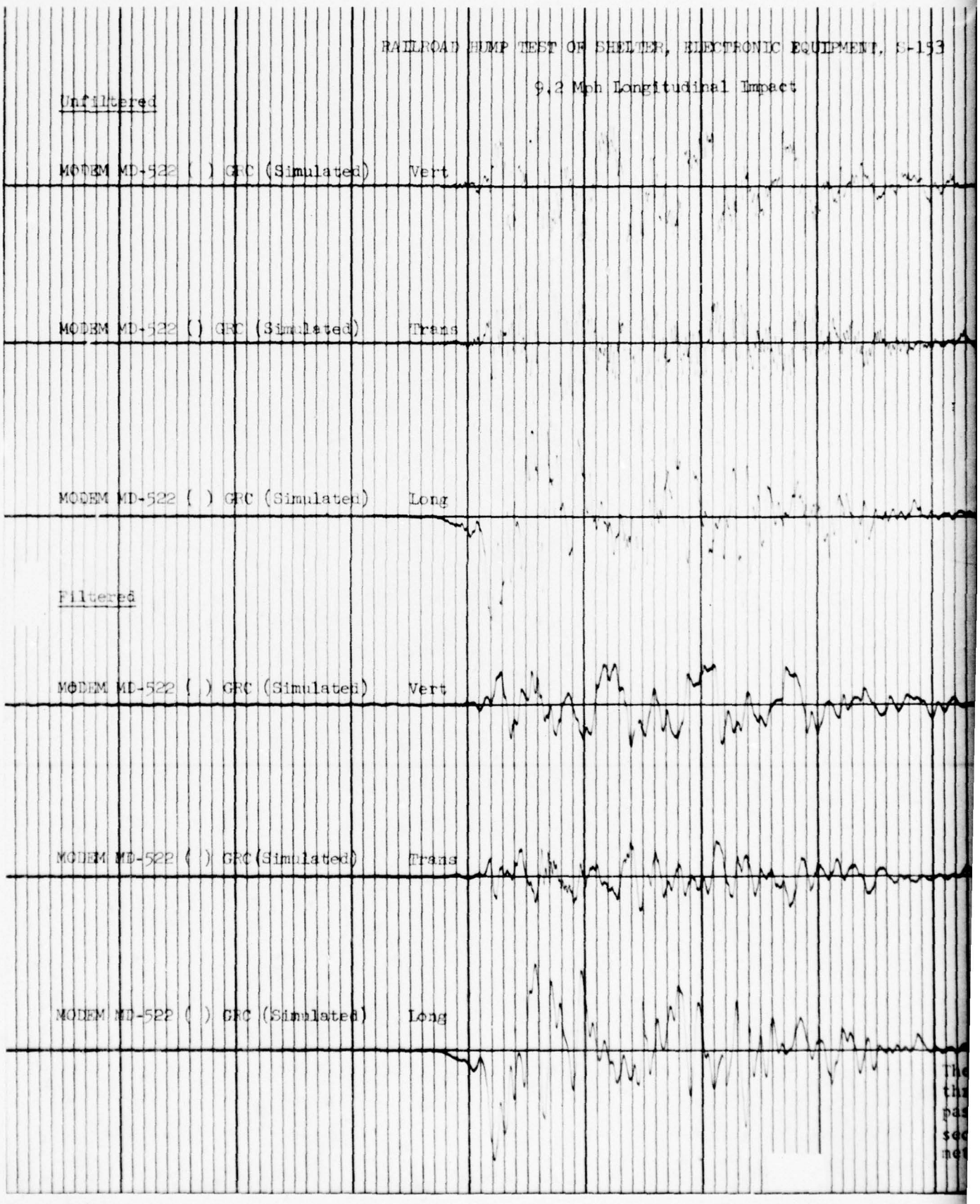
T OF SHELTER, ELECTRONIC EQUIPMENT, S-153

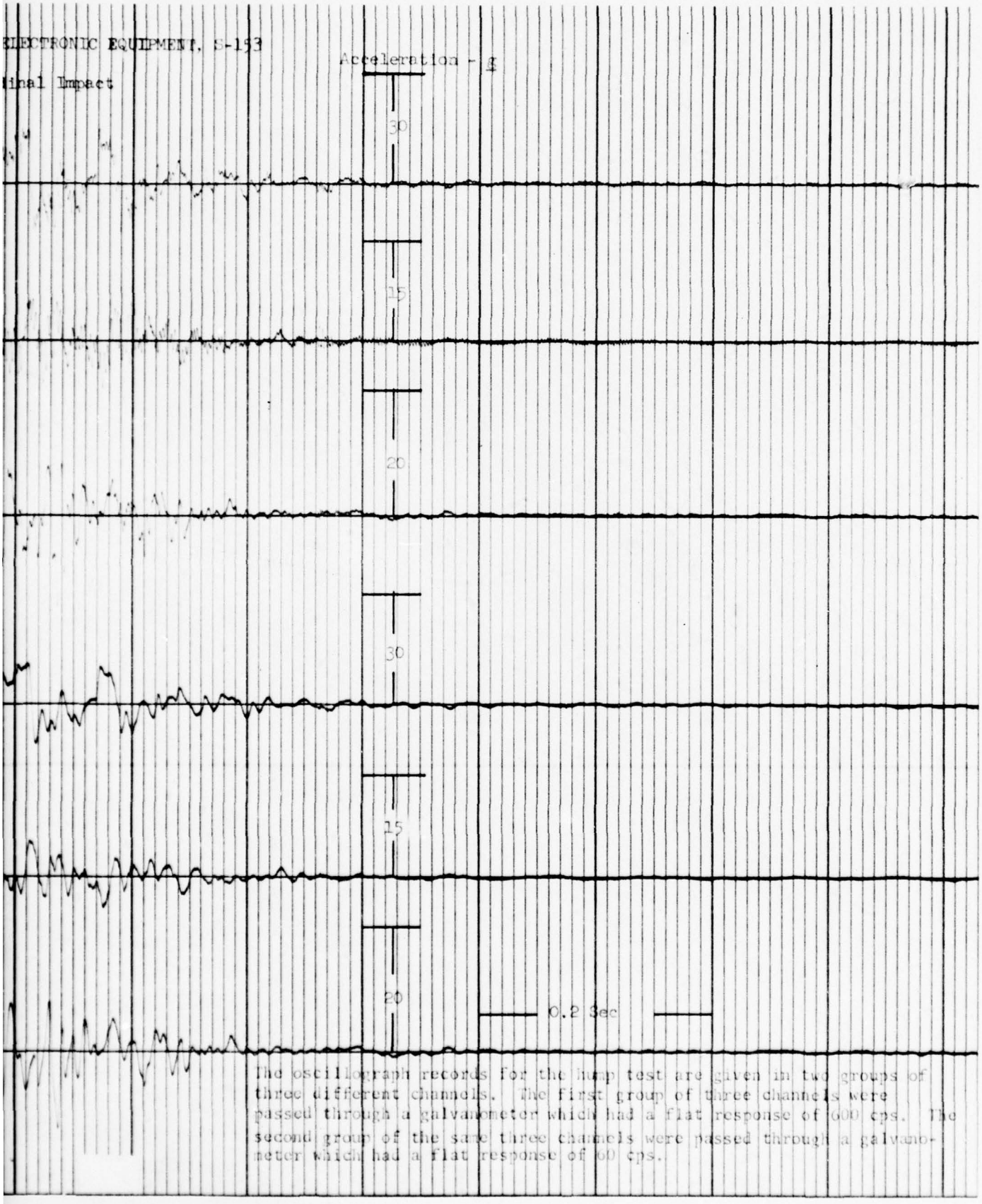
ph Longitudinal Impact



The oscillograph records for the hemp test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

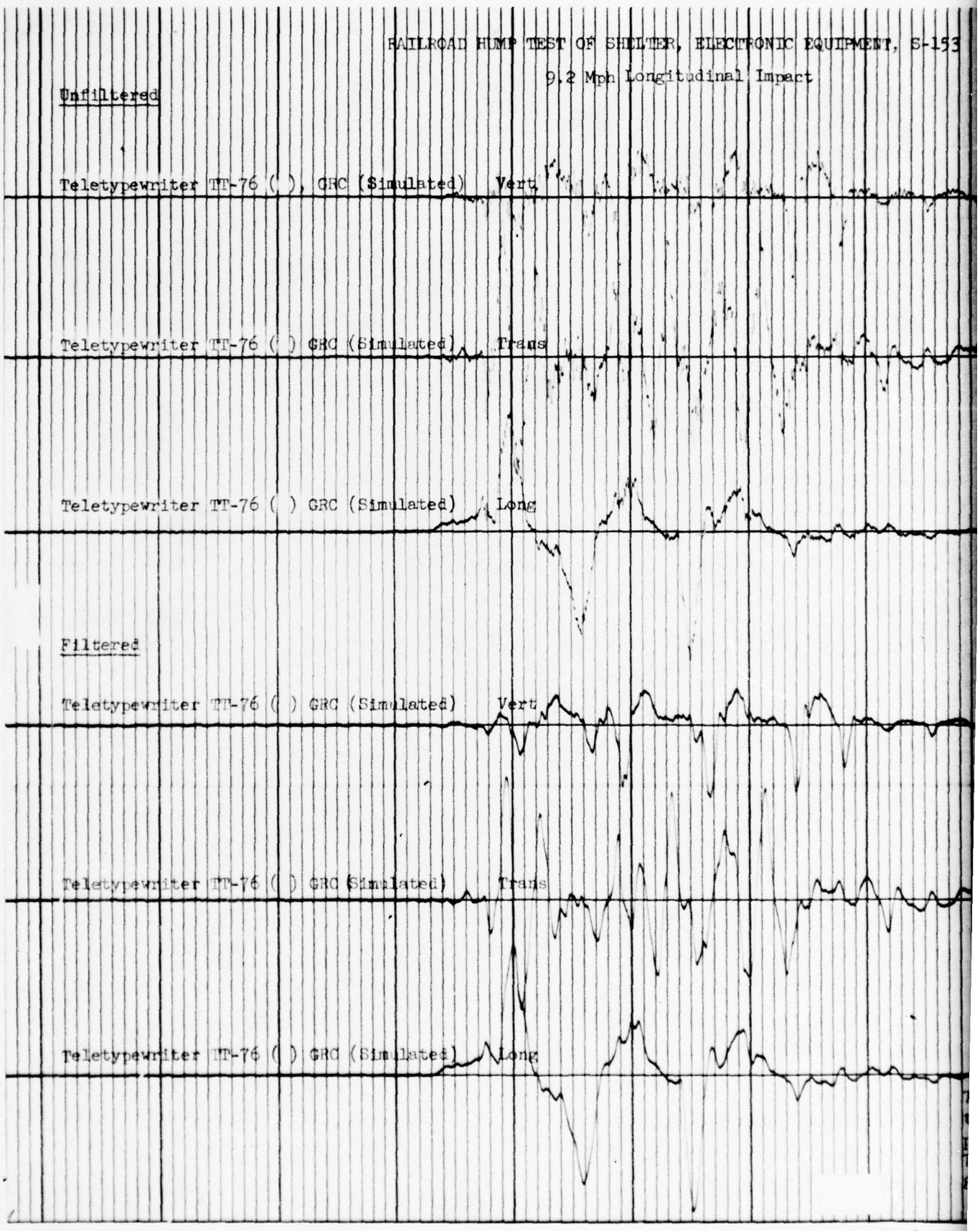
2


RAILROAD BUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Longitudinal Impact
Unfiltered
MODEM MD-522 ( ) GRC (Simulated) Vert
MODEM MD-522 ( ) GRC (Simulated) Trans
MODEM MD-522 ( ) GRC (Simulated) Long
Filtered
MODEM MD-522 ( ) GRC (Simulated) Vert
MODEM MD-522 ( ) GRC (Simulated) Trans
MODEM MD-522 ( ) GRC (Simulated) Long



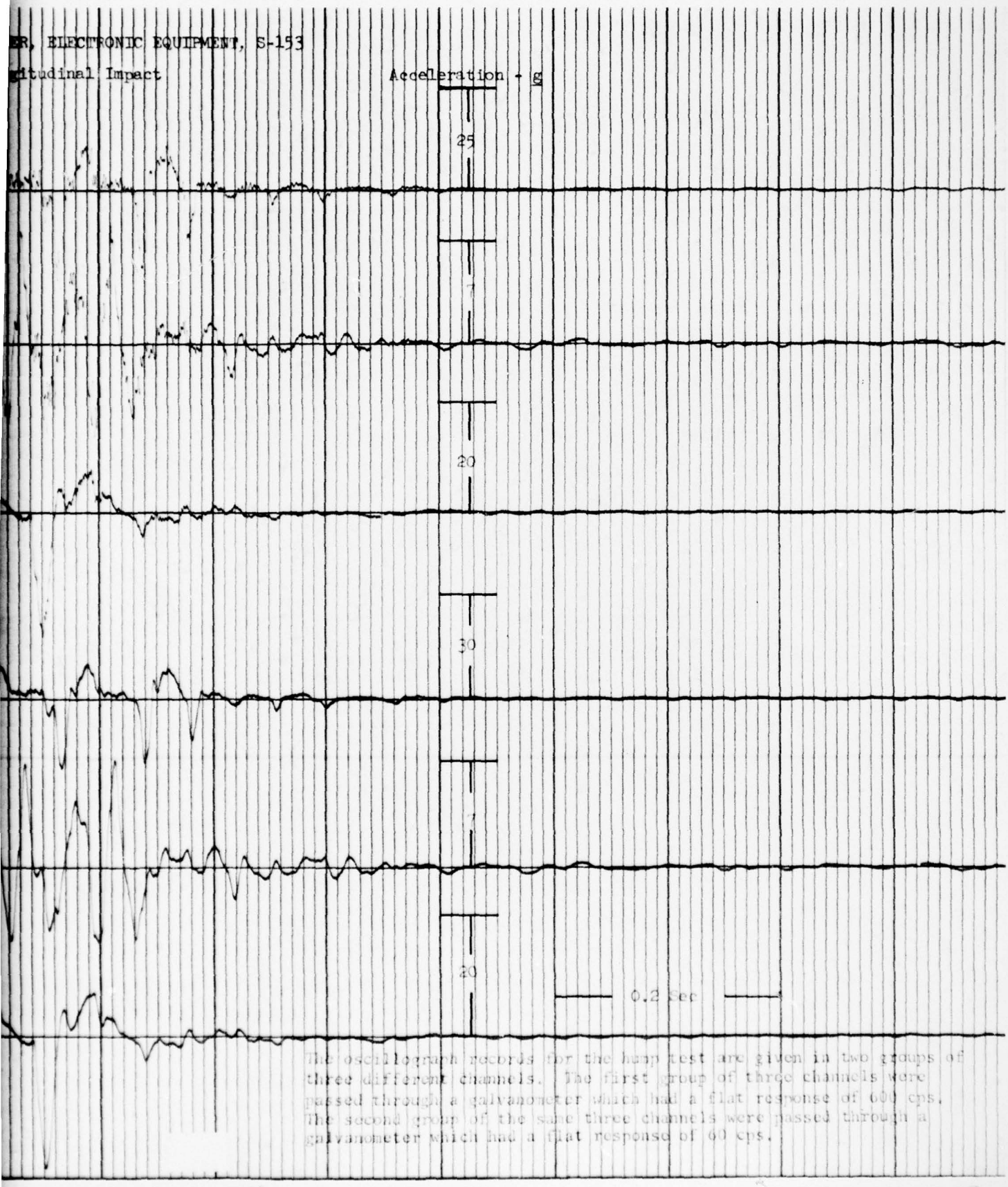
The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

2


RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Longitudinal Impact
Unfiltered
Teletypewriter TT-76 ( ), GRC (Simulated) Vert
Teletypewriter TT-76 ( ) GRC (Simulated) Trans
Teletypewriter TT-76 ( ) GRC (Simulated) Long
Filtered
Teletypewriter TT-76 ( ) GRC (Simulated) Vert
Teletypewriter TT-76 ( ) GRC (Simulated) Trans
Teletypewriter TT-76 ( ) GRC (Simulated) Long

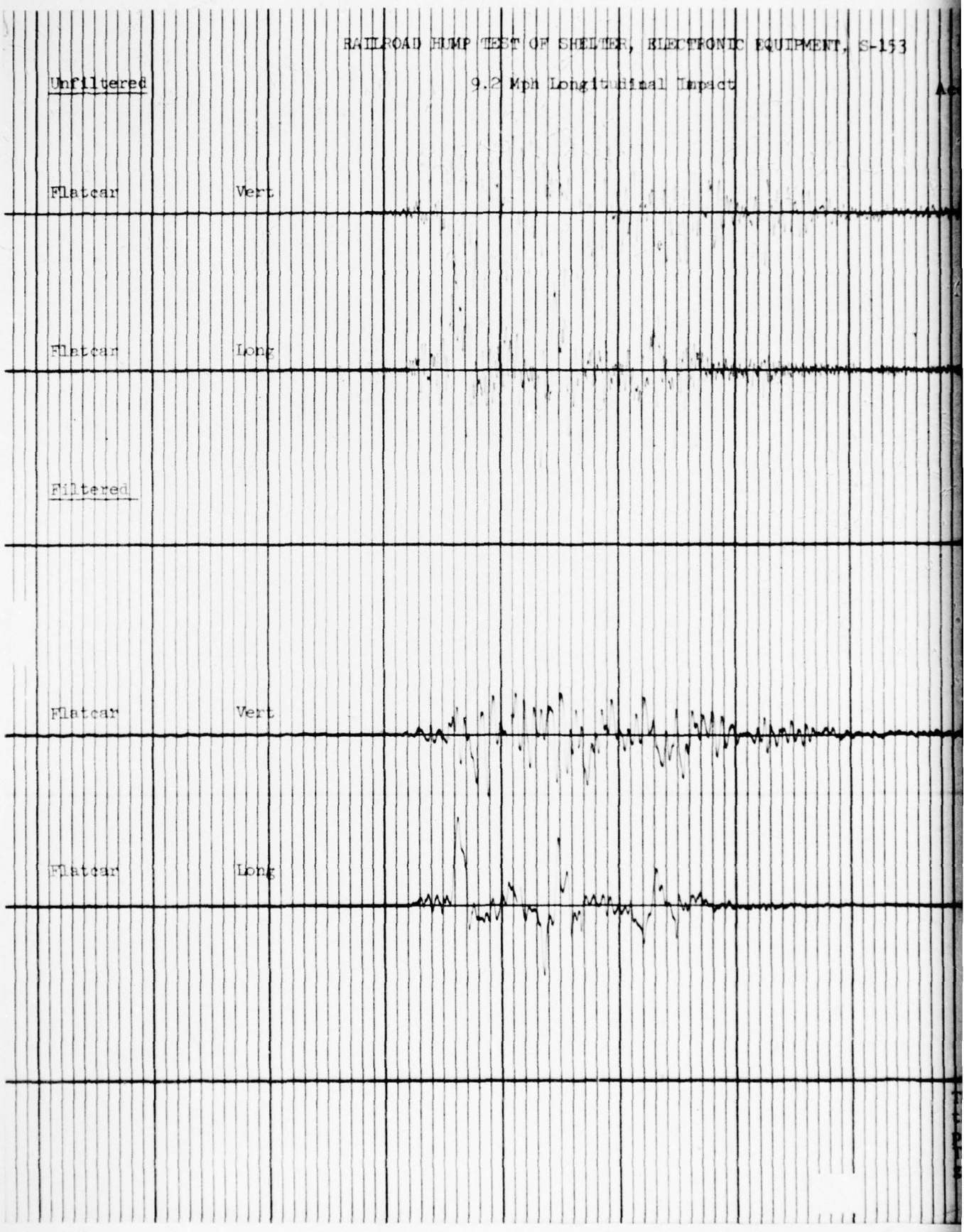
ER, ELECTRONIC EQUIPMENT, S-153

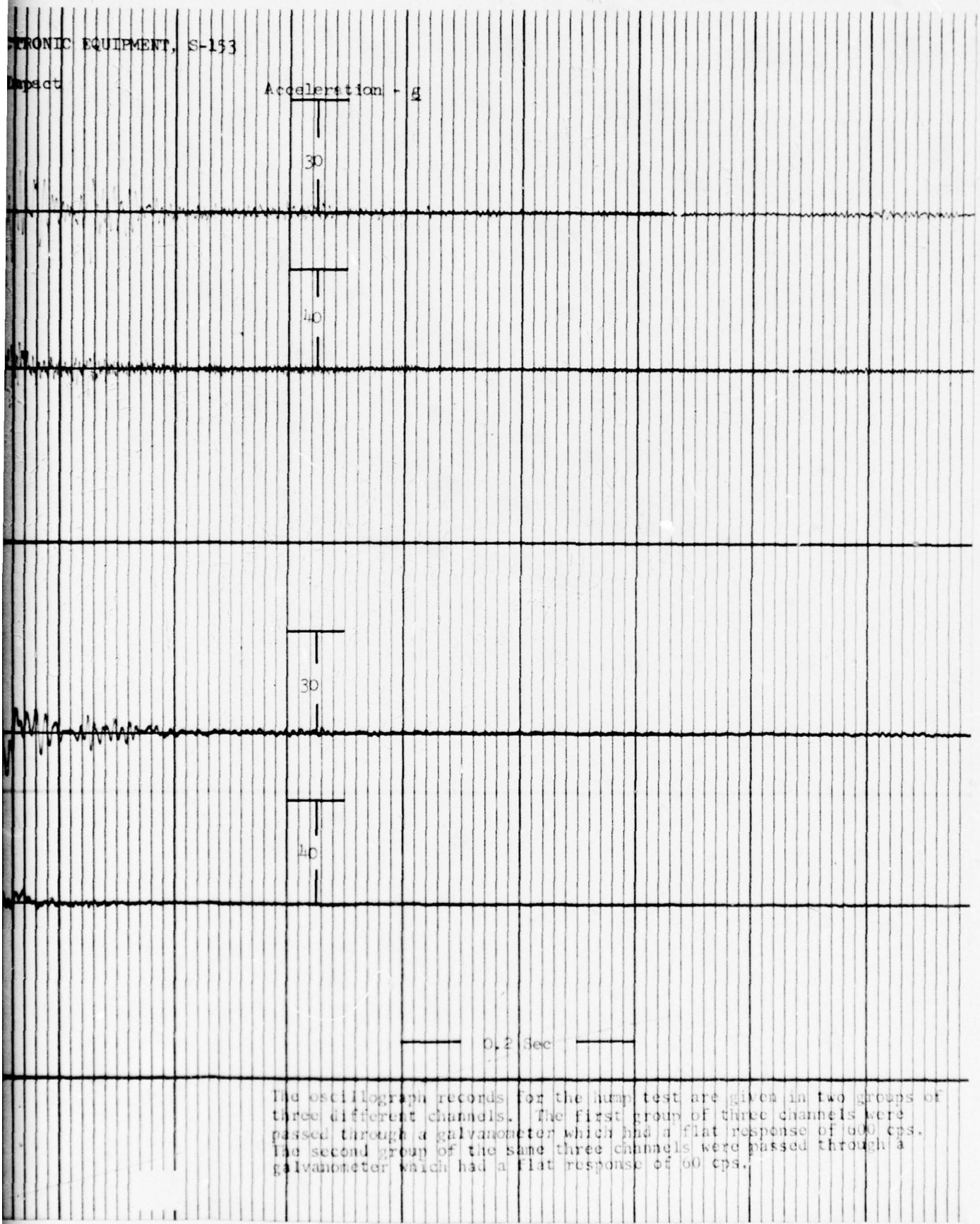
gitudinal Impact



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which has a flat response of 60 cps.

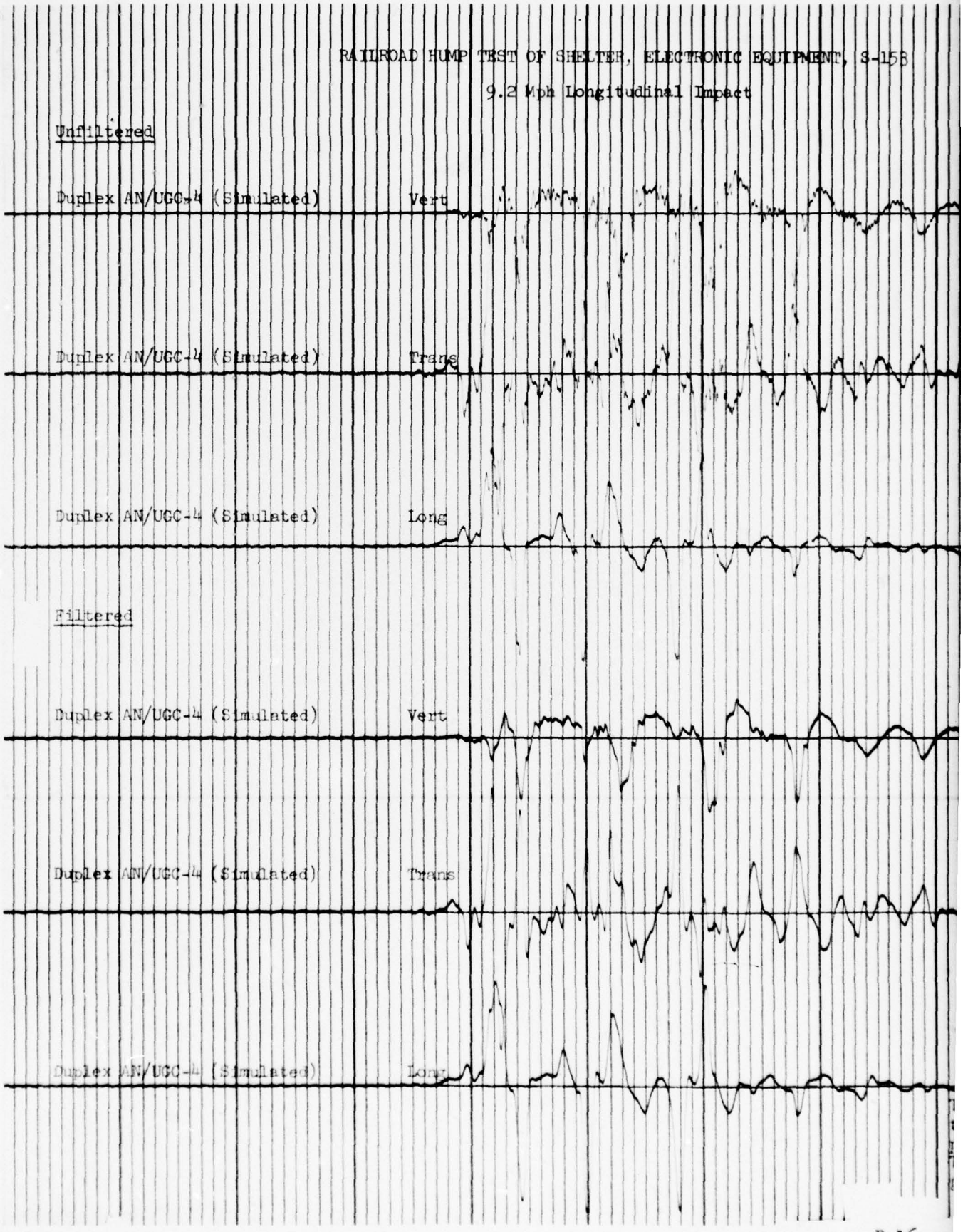
2

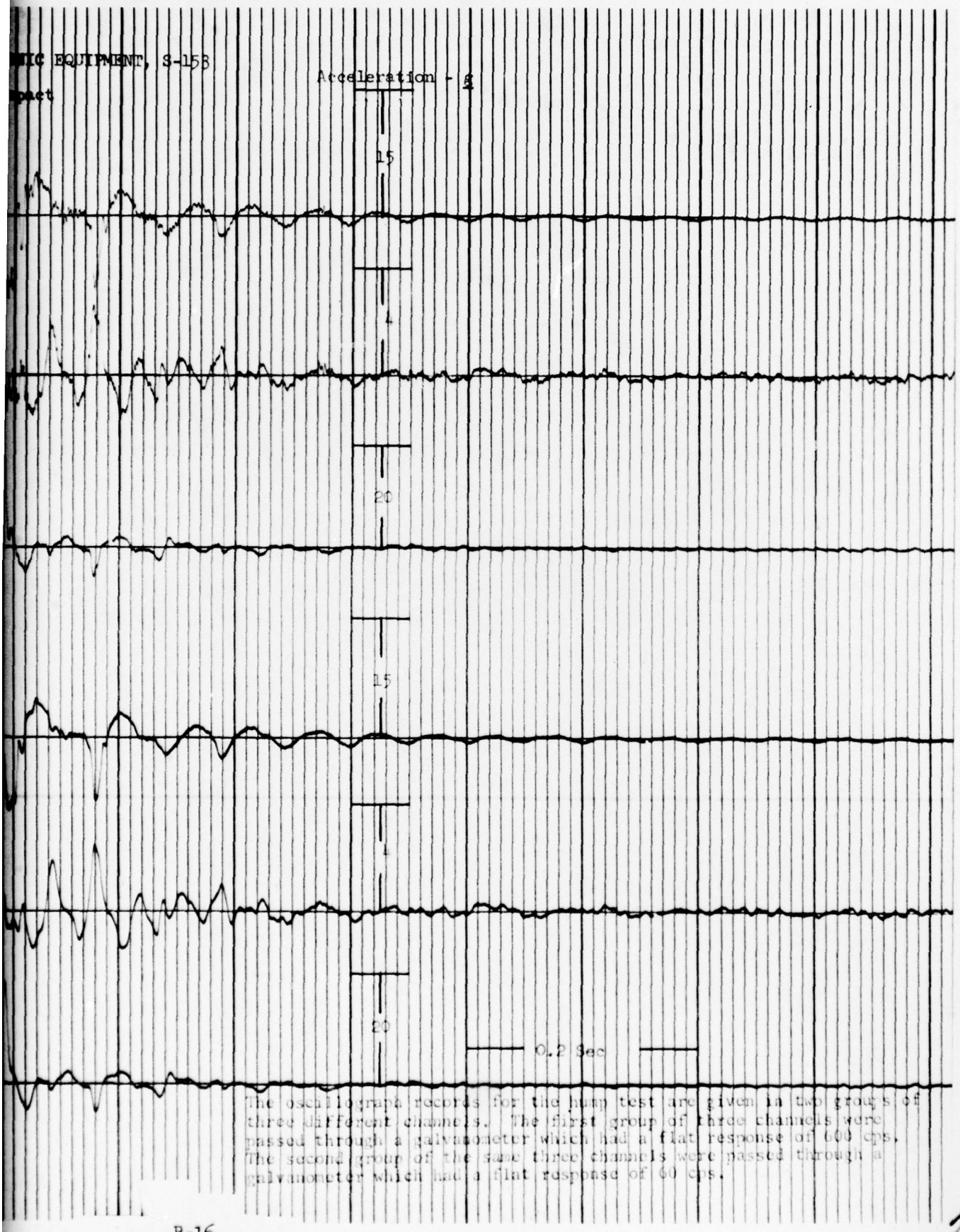

RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Longitudinal Impact
Unfiltered
Flatcar
Vert
Flatcar
Long
Filtered
Flatcar
Vert
Flatcar
Long



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

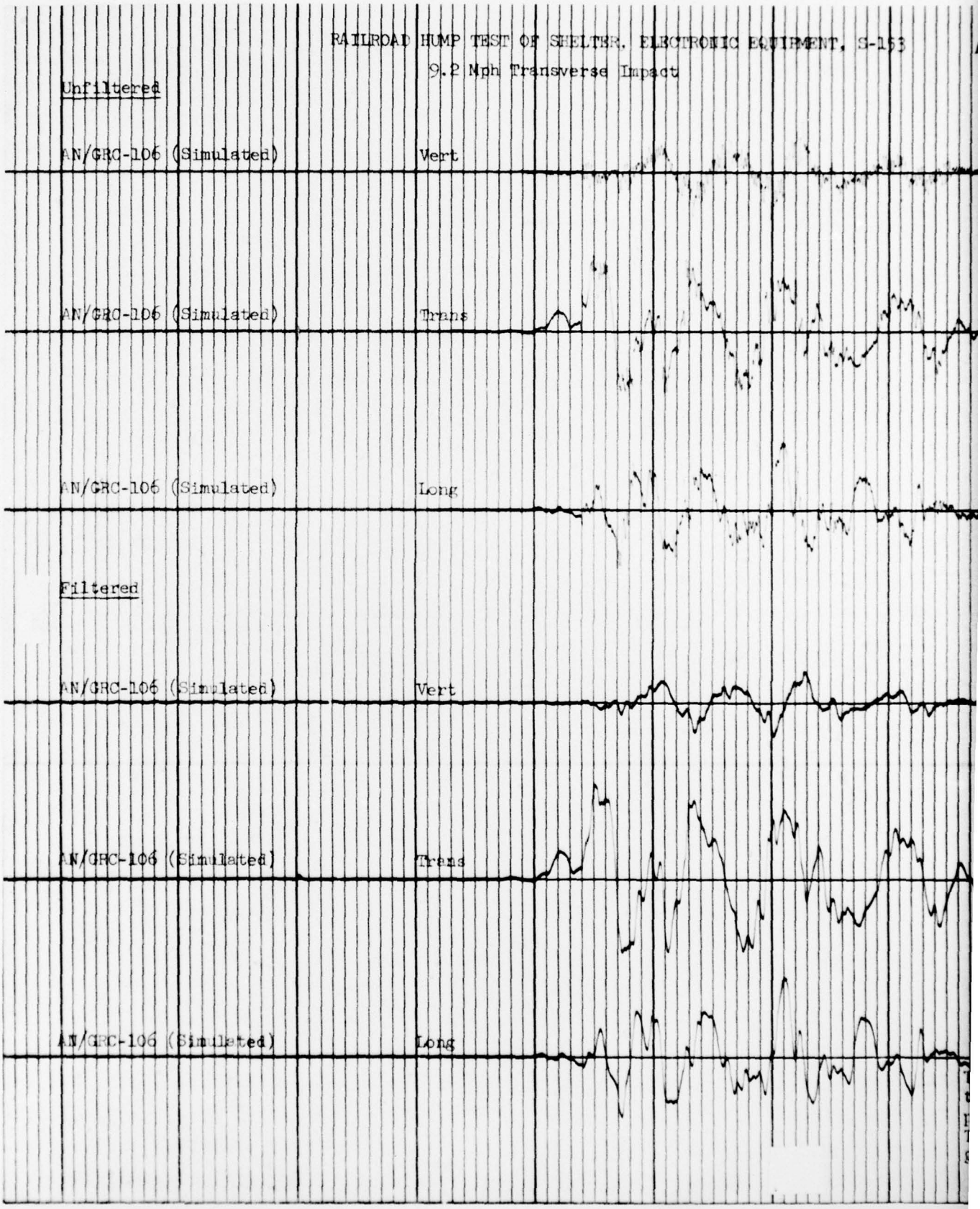
2

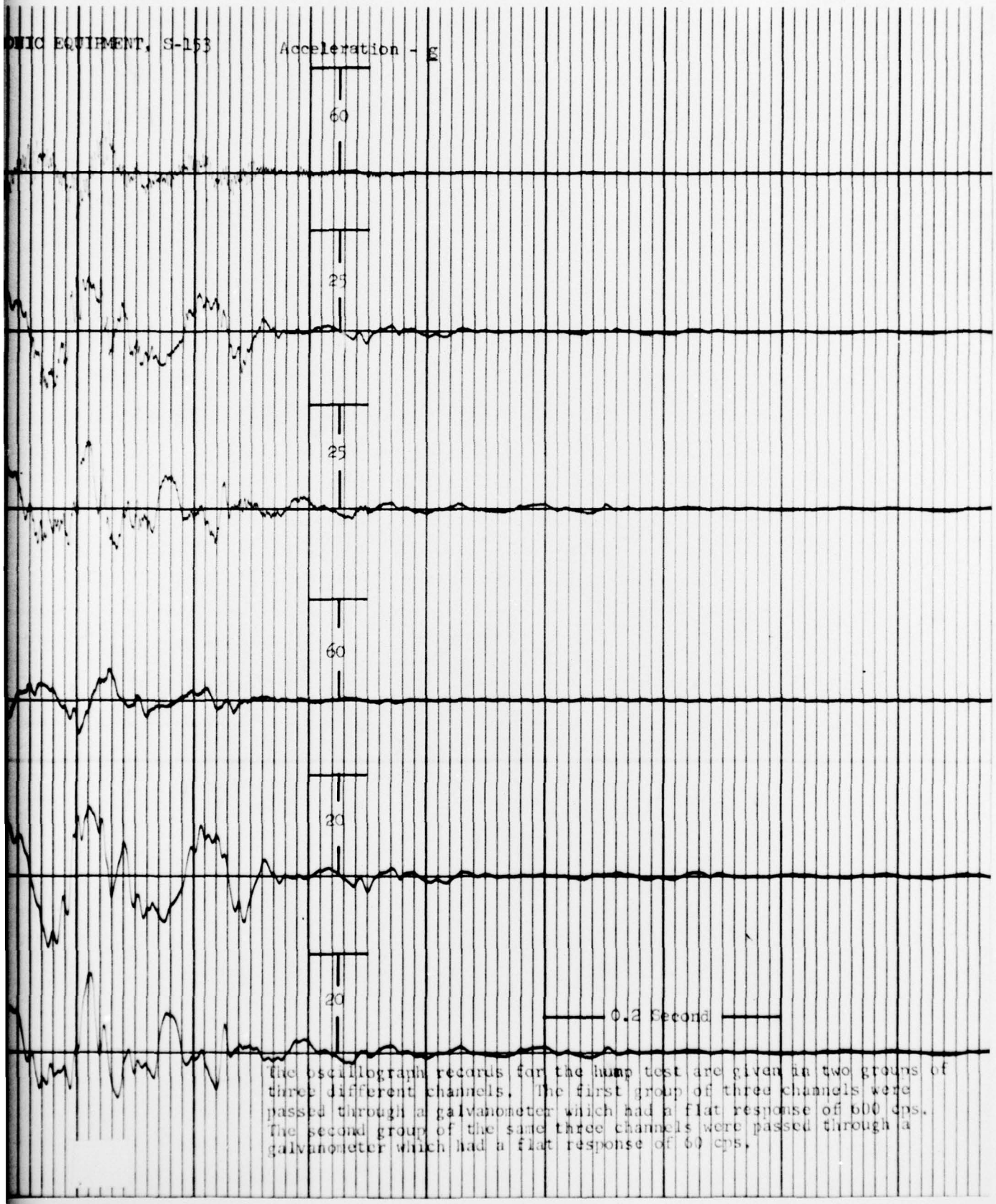

RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-155
9.2 Mph Longitudinal Impact
Unfiltered
Duplex AN/UGC-4 (Simulated) Vert
Duplex AN/UGC-4 (Simulated) Trans
Duplex AN/UGC-4 (Simulated) Long
Filtered
Duplex AN/UGC-4 (Simulated) Vert
Duplex AN/UGC-4 (Simulated) Trans
Duplex AN/UGC-4 (Simulated) Long



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

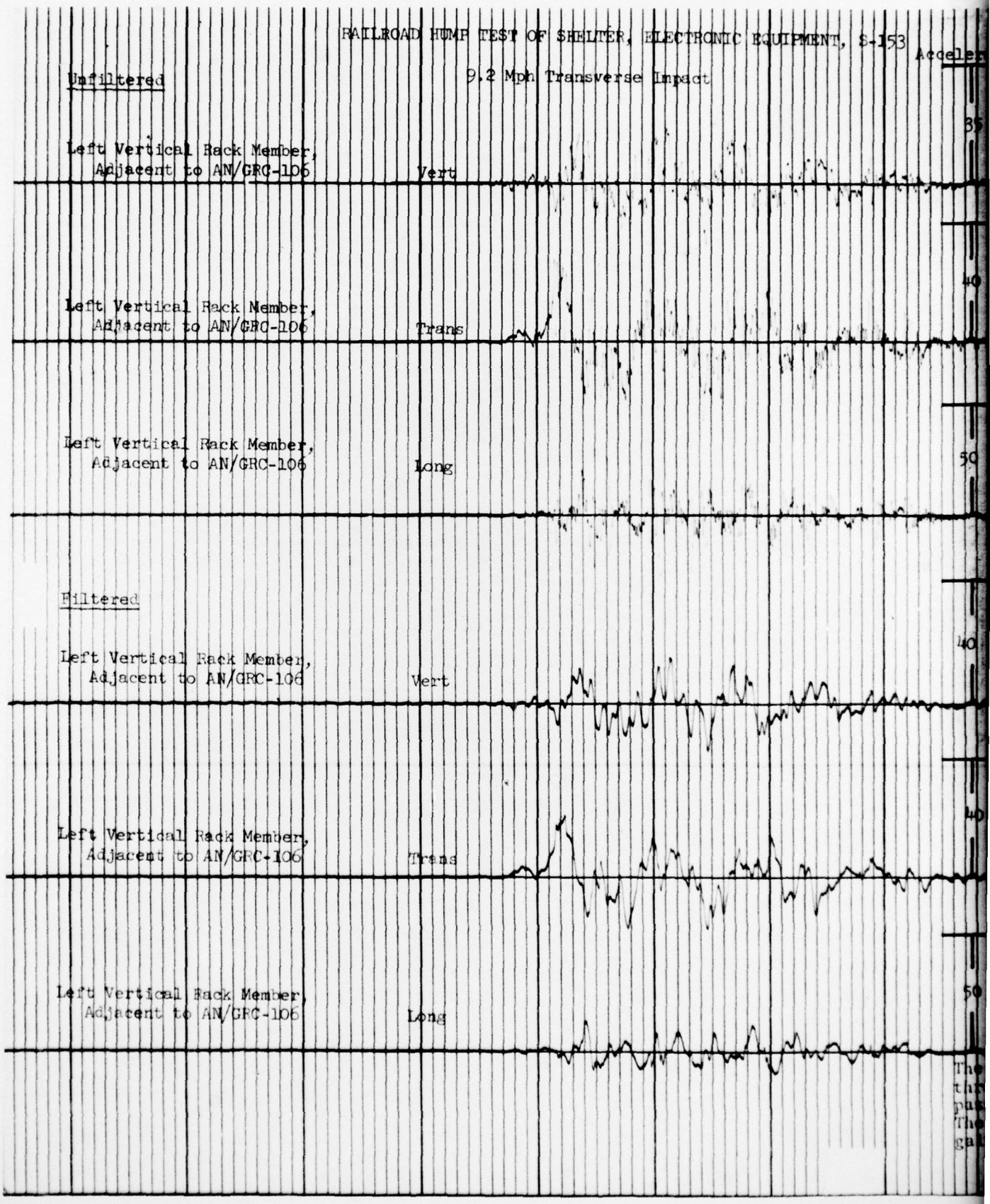
2

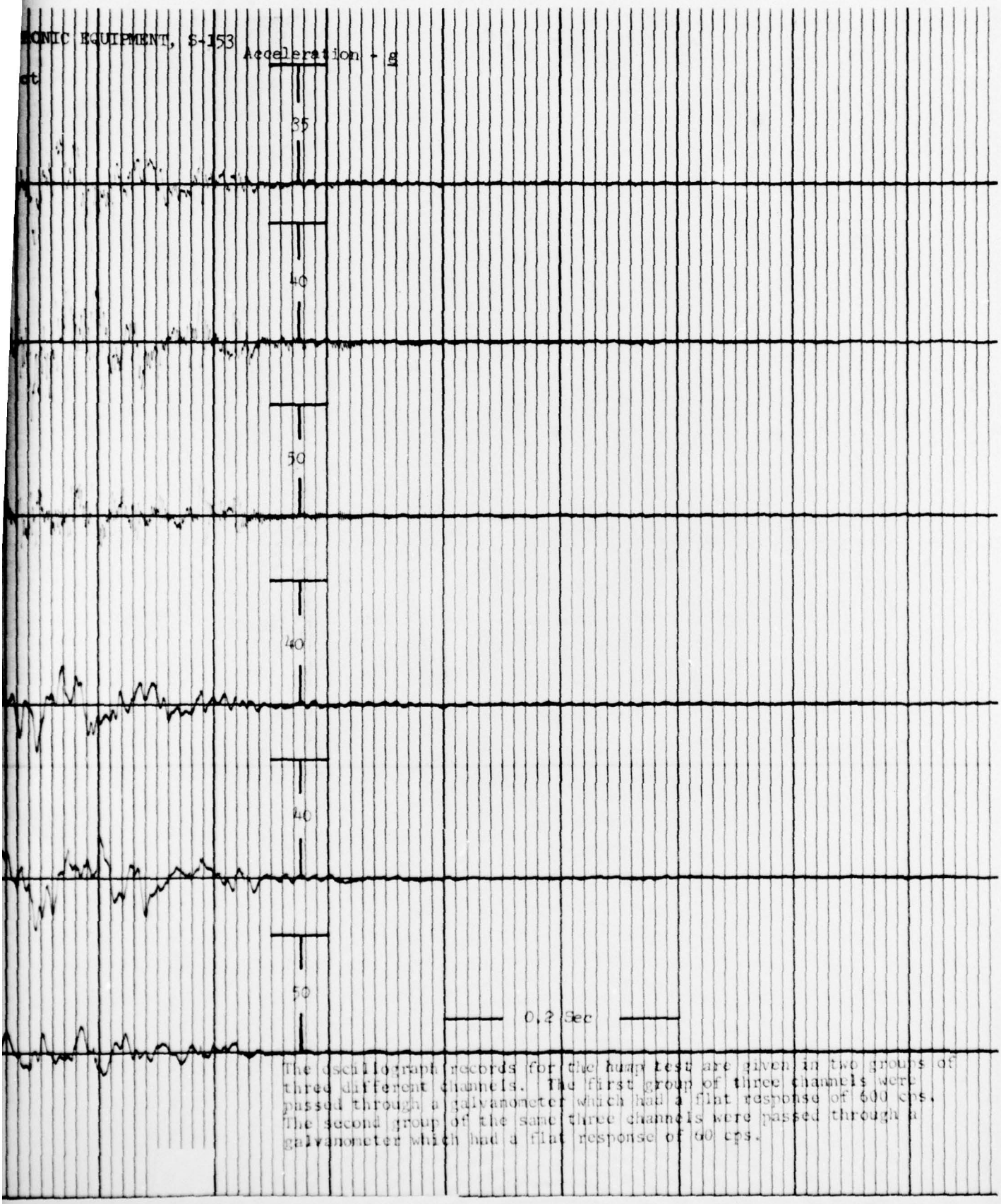

RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Unfiltered
AN/GRC-106 (Simulated)
Vert
AN/GRC-106 (Simulated)
Trans
AN/GRC-106 (Simulated)
Long
Filtered
AN/GRC-106 (Simulated)
Vert
AN/GRC-106 (Simulated)
Trans
AN/GRC-106 (Simulated)
Long



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

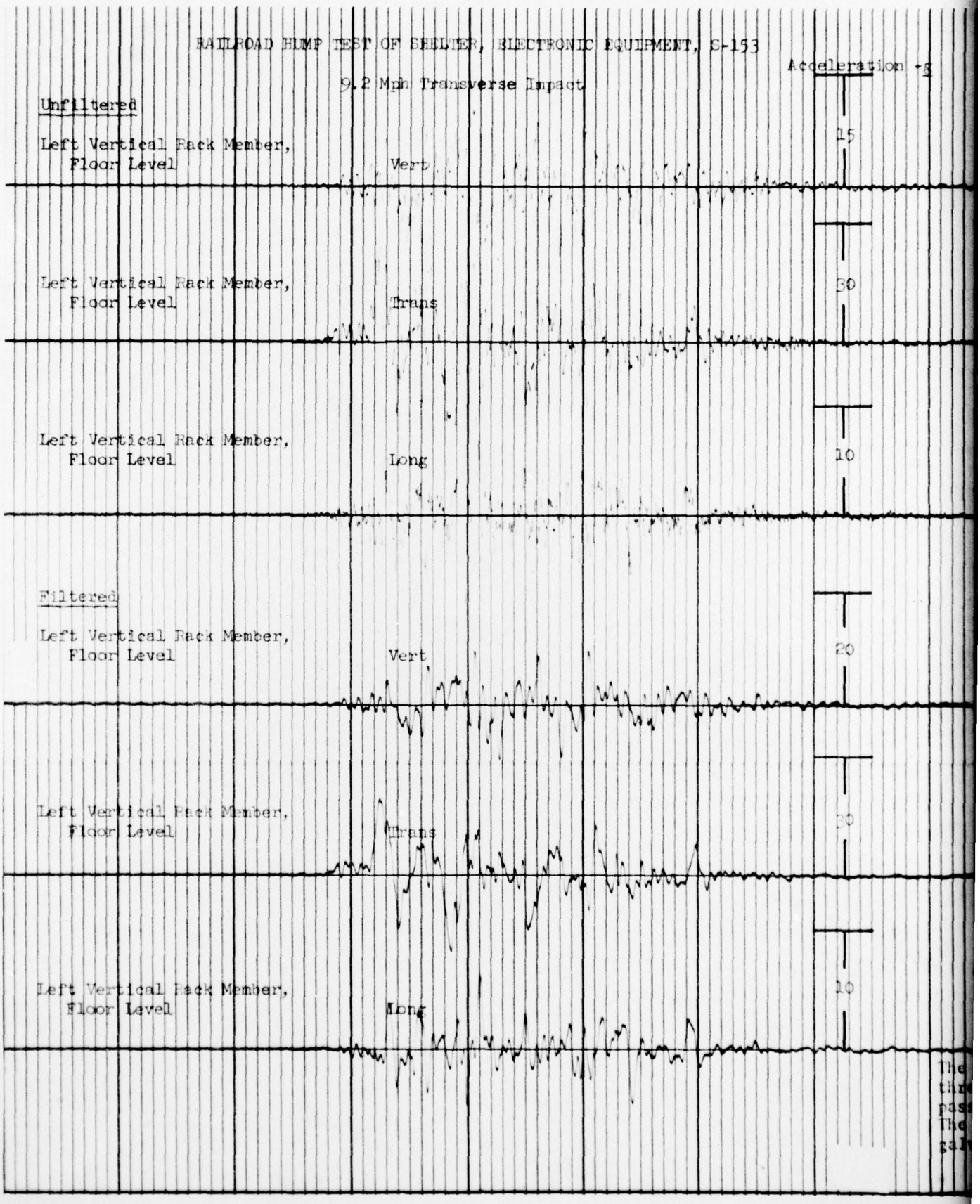
2


RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Accelera
Unfiltered
Left Vertical Rack Member, Adjacent to AN/GRC-106
Vert
Left Vertical Rack Member, Adjacent to AN/GRC-106
Trans
Left Vertical Rack Member, Adjacent to AN/GRC-106
Long
Filtered
Left Vertical Rack Member, Adjacent to AN/GRC-106
Vert
Left Vertical Rack Member, Adjacent to AN/GRC-106
Trans
Left Vertical Rack Member, Adjacent to AN/GRC-106
Long
35
40
50
40
40
50



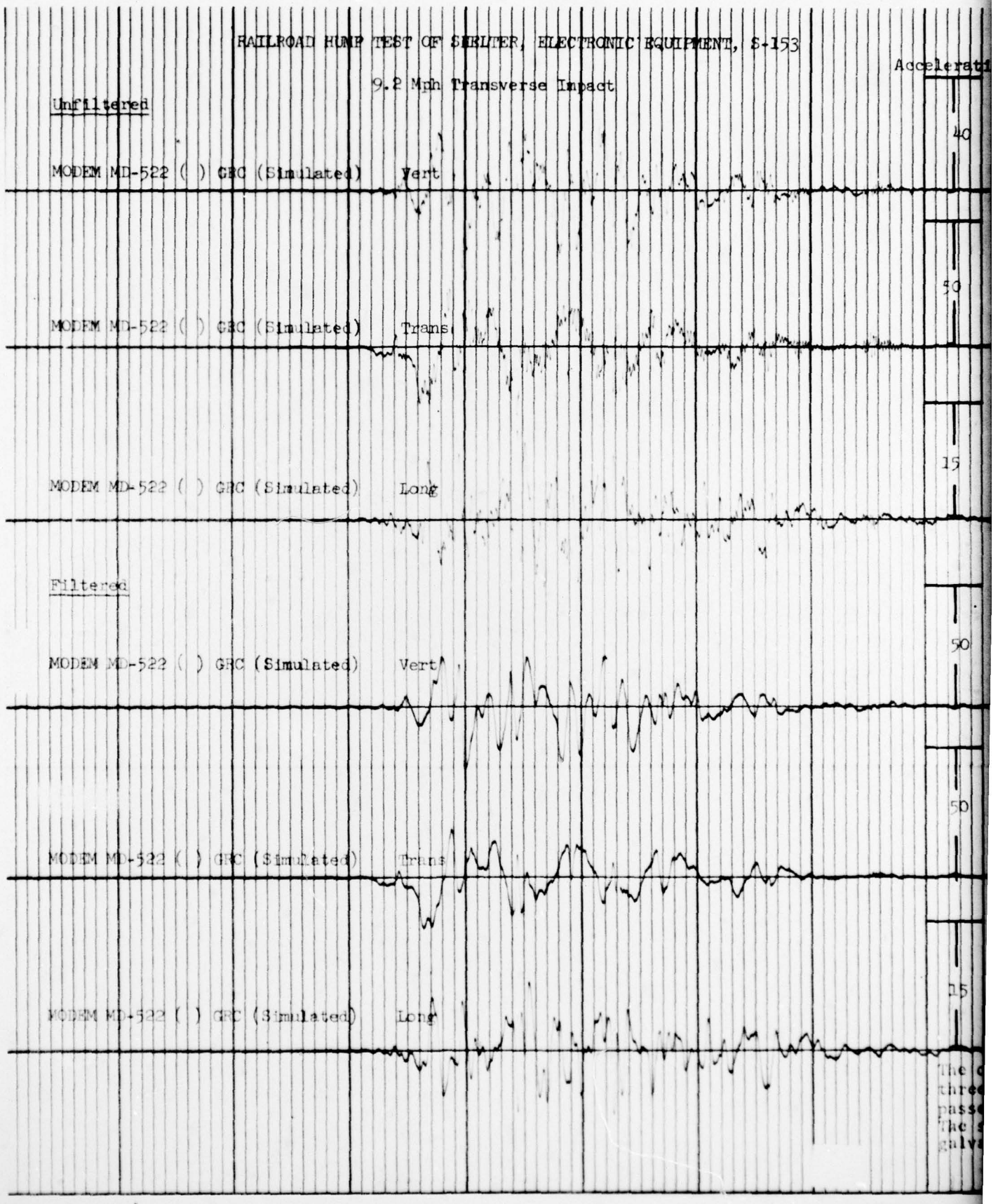
The oscillograph records for the hung test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

2


RAILROAD BUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Acceleration +g
Unfiltered
Left Vertical Rack Member, Floor Level
Vert
15
Left Vertical Rack Member, Floor Level
Trans
30
Left Vertical Rack Member, Floor Level
Long
10
Filtered
Left Vertical Rack Member, Floor Level
Vert
20
Left Vertical Rack Member, Floor Level
Trans
30
Left Vertical Rack Member, Floor Level
Long
10

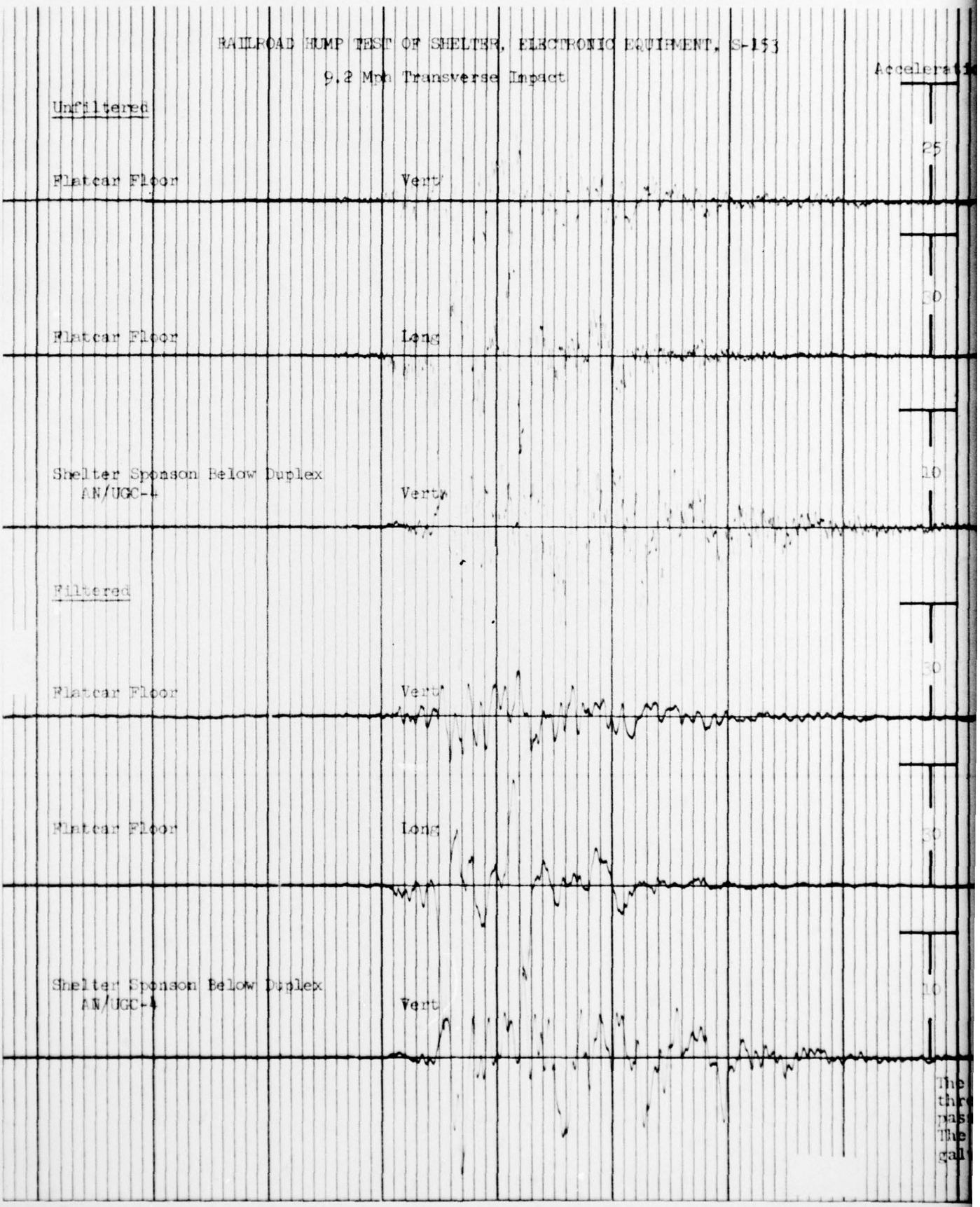
The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

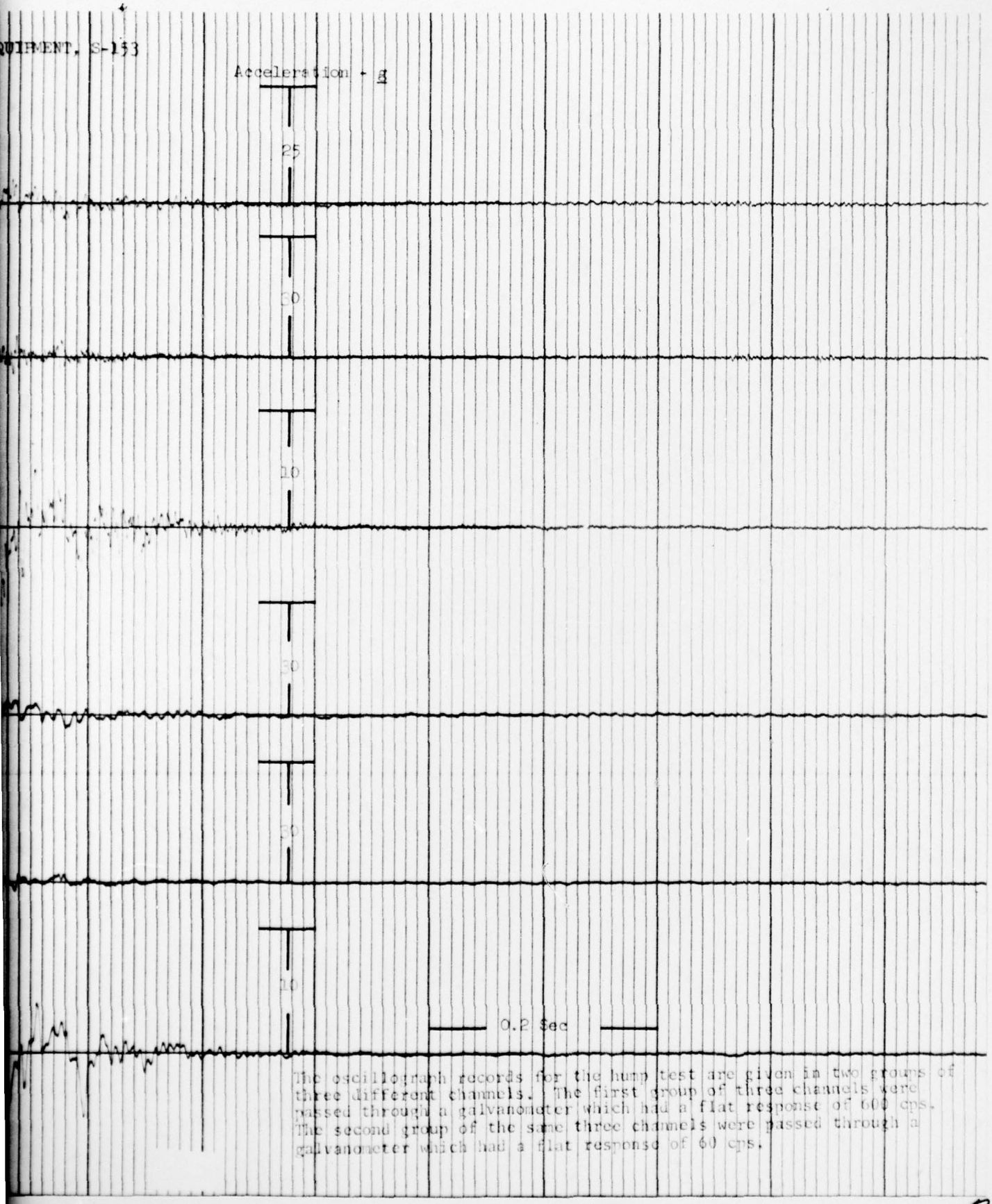
2


RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Accelerati
Unfiltered
MODEM MD-522 ( ) CRC (Simulated) Vert
MODEM MD-522 ( ) CRC (Simulated) Trans
MODEM MD-522 ( ) CRC (Simulated) Long
Filtered
MODEM MD-522 ( ) CRC (Simulated) Vert
MODEM MD-522 ( ) CRC (Simulated) Trans
MODEM MD-522 ( ) CRC (Simulated) Long
40
50
15
50
50
15

The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

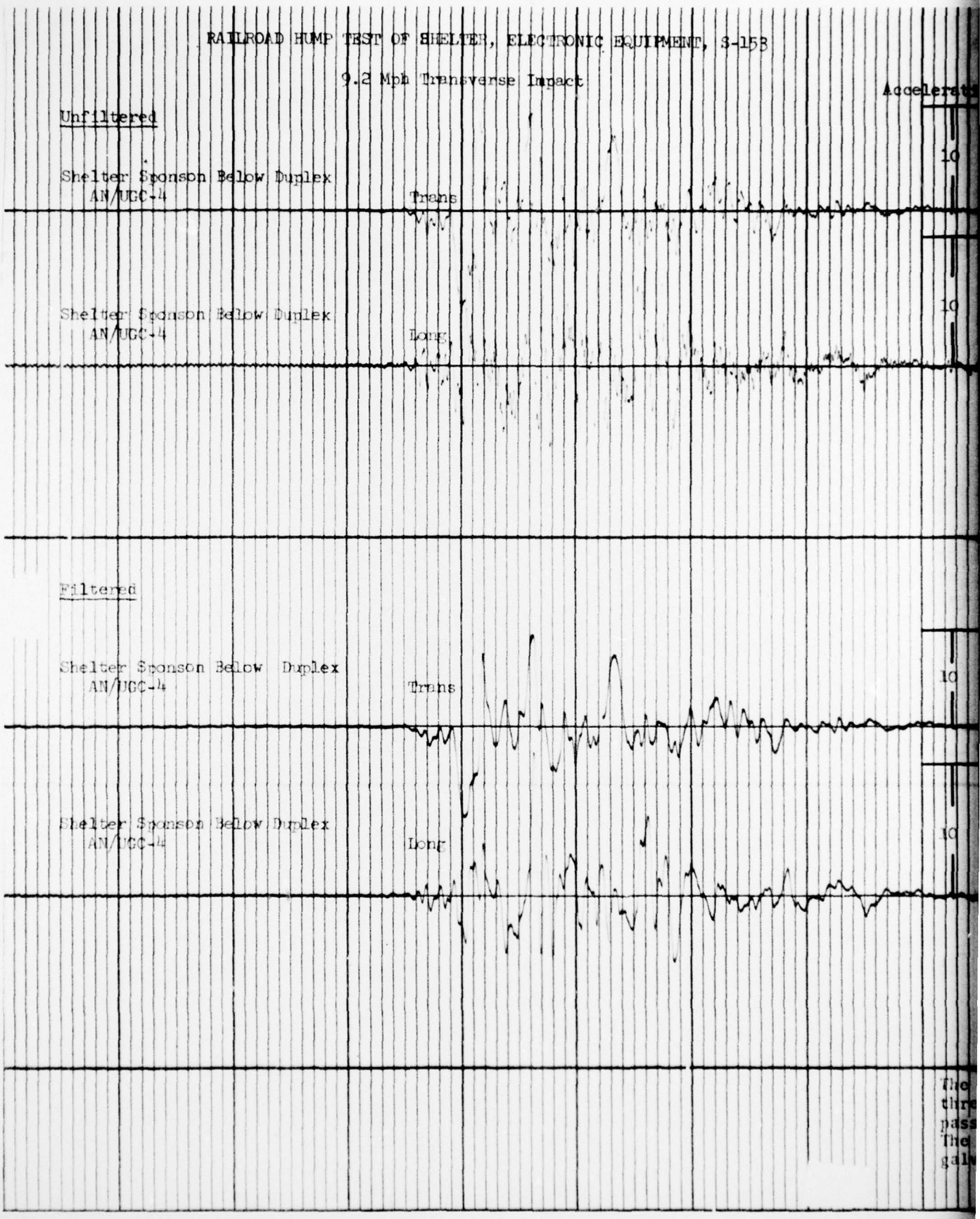
2

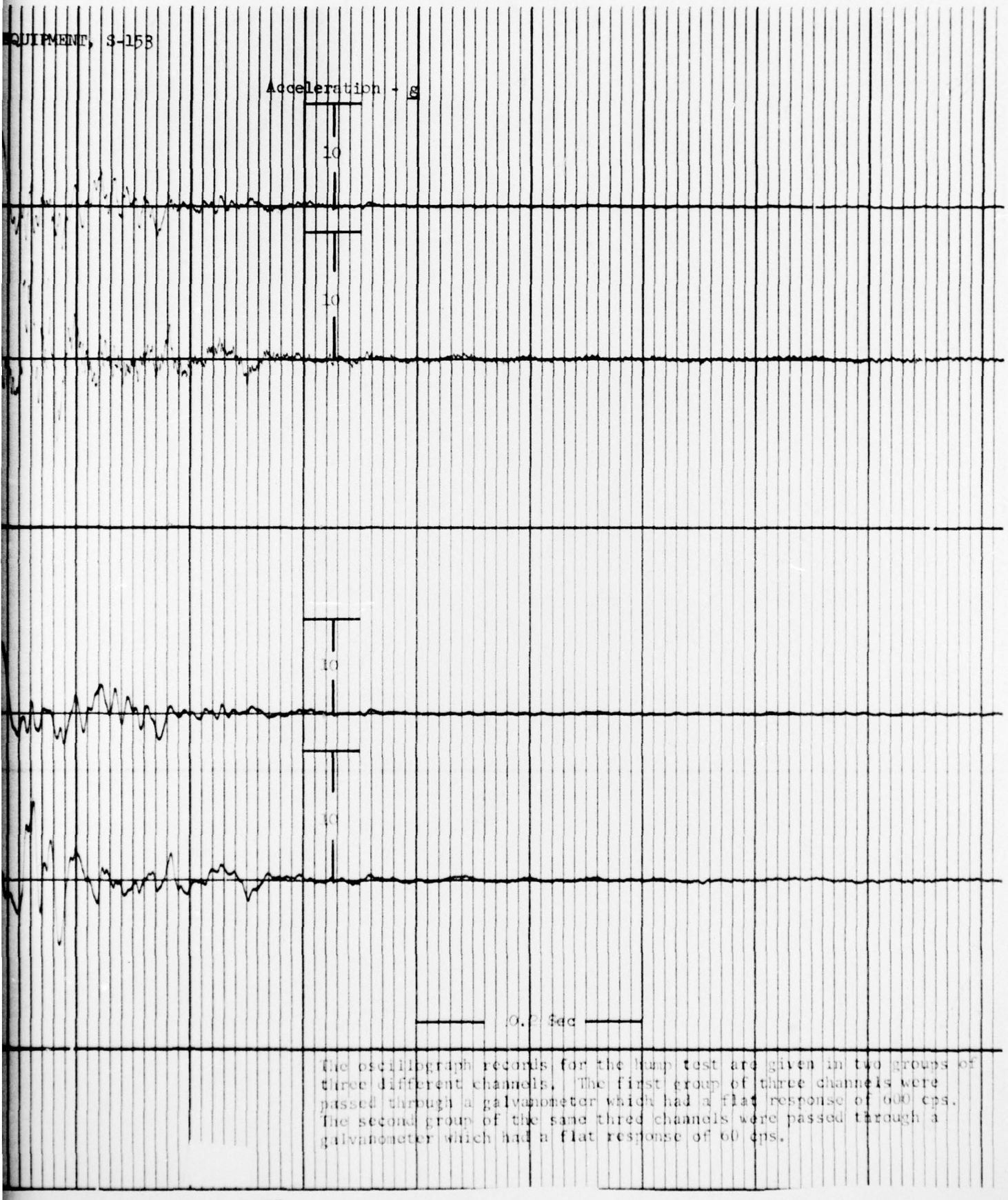

RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Unfiltered
Flatcar Floor
Vert
Flatcar Floor
Long
Shelter Sponson Below Duplex AN/UGC-4
Vert
Filtered
Flatcar Floor
Vert
Flatcar Floor
Long
Shelter Sponson Below Duplex AN/UGC-4
Vert



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

2


RAILROAD HUMP TEST OF SHELTER, ELECTRONIC EQUIPMENT, S-153
9.2 Mph Transverse Impact
Unfiltered
Shelter Sponson Below Duplex AN/UGC-4
Trans
Shelter Sponson Below Duplex AN/UGC-4
Long
Filtered
Shelter Sponson Below Duplex AN/UGC-4
Trans
Shelter Sponson Below Duplex AN/UGC-4
Long



The oscillograph records for the hump test are given in two groups of three different channels. The first group of three channels were passed through a galvanometer which had a flat response of 600 cps. The second group of the same three channels were passed through a galvanometer which had a flat response of 60 cps.

2

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USATECOM Project No. 6-4-3112-05-G
RDT&E Project No. 1G640306D488, Report No. DPS-1357
43 pages, 23 illustrations

Unclassified Report

An engineer design road test and a railroad hump test were performed on the electronic equipment shelter, S-153, which contained simulated components of the radio/teletypewriter system, AN/GRC-122. These tests were conducted to measure shock and vibration response and to evaluate the structural adequacy of the system during road transport on the M37 truck and during railroad hump tests. It is recommended that the damaged mountings be redesigned or modified and that additional hump tests be conducted to evaluate these modifications.

AD_____ Accession No._____

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